# User Information and the Bus Stop

*Designs and Applications in the United States and Canada*

A Thesis
Presented to
The Academic Faculty

by

Christopher Silveira

In Partial Fulfillment
of the Requirements for the Degree
Master of Science in Civil Engineering in the
School of Civil and Environmental Engineering
And
Master of City and Regional Planning in the
School of City and Regional Planning

Georgia Institute of Technology
May 2013

# User Information and the Bus Stop

*Designs and Applications in the United States and Canada*

Approved by:
Dr. Kari Watkins, Advisor
School of Civil and Environmental Engineering
*Georgia Institute of Technology*

Dr. Jiawen Yang
School of City and Regional Planning
*Georgia Institute of Technology*

Michael Dobbins, FAIA, FAICP
School of City and Regional Planning
*Georgia Institute of Technology*

Date Approved: January 8, 2013

# ACKNOWLEDGEMENTS

I would like to thank the faculty at Georgia Tech, particularly my advisor, Dr. Kari Watkins, whose counsel and attention at every milestone have sharpened my focus and kept me on task and whose flexibility has allowed me to see my way through this process. I would also like to express my gratitude to Michael Dobbins and Dr. Jiawen Yang, who have taken the time to review my work.

I am sincerely obliged to the employees of AirTran Airways, Delta Airlines, Southwest Airlines, Amtrak, Megabus, and the transit agencies for moving me to, or within, each city safely, efficiently, and inexpensively, without whose services I would not have reached so many diverse places. Furthermore, I am grateful to several notable transit agencies and their staff with whom I engaged, and from whom I derived much inspiration, including MARTA in Atlanta, GA; Metro Transit in Minneapolis, MN; WMATA in Washington, DC; King County Metro in Seattle, WA; RTD in Denver, CO; MBTA in Boston, MA; NYCT in New York, NY; and SEPTA in Philadelphia, PA.

I wish to thank Nicholas Roberts and Ryan VanSickle for their contributions to my research with photography of MUNI in San Francisco and DART in Dallas, respectively. Nicholas, whose reliability on which I can always count, has been an unwavering source of support and friendship throughout graduate school. Ryan, whose curiosities spurred my own, has assisted me without hesitation and with boundless energy.

Lastly, I would like to thank my family, without whom I would not be here.

# LIST OF TABLES

# LIST OF FIGURES

# SUMMARY

Bus stops are interwoven into the urban landscape, providing constant visibility of the transit system and offering upfront information to users. This contact creates an ever-present opportunity for transit agencies to market their services to the public and attract ridership. The purpose of this thesis is to help transit agencies exploit this opportunity through the development and deployment of user information at bus stops. The thesis examines how agencies are leveraging bus stop infrastructure in the United States and Canada. Site visits were conducted at twenty-nine transit agencies across the continent with observations photographed and processed into matrices. The photographs provide examples of innovative ways in which agencies have employed elements, while the matrices reveal the current state of the practice. The thesis concludes with recommendations for the conceptualization and development of bus stop signage that integrate many of these innovative elements as well as ADA regulations to improve user information at transit agencies.

The findings of this thesis may be of interest to transit agencies that are seeking to construct a new or improve upon an existing user information system as well as to those interested in or studying public transit, wayfinding, or environmental graphic design. While there exists a large degree of difference as to the level of information that is made available to users in different transit agencies, all agencies have room to improve.

# CHAPTER 1: INTRODUCTION

Transit agencies have many faces that are in direct contact with the public on a daily basis. These faces range from the people who speak with users like bus operators and customer service representatives to the vehicles that move users and the stations from which they depart. One of these faces, bus stop signage, is one of a transit agency's most visible elements. They facilitate the extension of service throughout a region, calling attention to their presence. They market to all passers-by without regard for the mode by which those people move. They also provide a medium on which a transit agency can distribute information. With the contact that bus stops have with the general public, they embody a standing opportunity to do more than mark a stop location; they can inform, they can impart confidence, and they can encourage ridership.

## 1.1 Context

Navigation of bus systems is a complex process. Fixed route buses do not provide curb-to-curb service that moves people directly from Point A to Point B whenever and wherever people wish to go. As a result, trips require substantial knowledge of the transit system: the routes, the schedules, the fares, and much more. In order to simplify the process, transit agencies allocate significant resources to the production and maintenance of user information. These include remote information resources such as web-based information found on an agency website or a third-party application as well as local information resources such as site-based information found on a bus stop sign.

While significant interest and research has been directed toward remote resources as advancements in technology help to increase the market penetration of smartphones, research in local resources has been comparatively stagnant over the past decade.

Despite an overall increase in access to remote information resources, a sizeable segment of the population still lacks the ability to retrieve information through web-based platforms. According to Nielsen and comScore surveys, in June 2012, market penetration of mobile phones in the United States hovered around 90 percent of people age 13 and older; while market penetration of smartphones rose to approximately 50 percent of people age 13 and older (Nielsen, 2012; comScore, 2012). Nielsen also stated that two out of every three Americans who acquired a new mobile phone in the last three months selected a smartphone instead of a feature phone. While these statistics point to increased use of web-enabled phones, it also points to the 50 percent of Americans who still lack smartphones as well as the one in three people who continue to choose feature phones. Moreover, a disproportionately large segment of the population that continues to avoid smartphones includes older Americans. This group, along with impoverished Americans, makes up the majority of the transit dependent population.

As the population of the United States continues to age, transit agencies must respond in an appropriate manner to best serve all segments of its ridership. Yet, tax receipts, a primary source of income for many transit agencies, have been lower than projected due to the recession economy and slow recovery. Therefore, agencies have been forced

to cut costs where possible, making imperative the efficient use of existing resources. Many agencies view remote resources as a more cost-effective approach to disseminating information than an expansion of bus stop infrastructure. However, because smartphones are not yet found in all households, remote resources should not be conceived as a *replacement of* local resources, but rather, they should be conceived as a *supplement to* local resources, presenting data such as dynamic real-time information, that which, without smartphones or expensive electronic sign boards, would not be possible to convey.

Bus stops, with their accompanying infrastructure and user information, are the initial and most extensive access points from which users enter the bus system. This quality presents every transit agency with an opportunity to provide considerable amounts of information on space that they already fabricate and maintain and that which may work in concert with remote resources. While bus stops intrinsically designate locations at which users should wait for a bus, they also advertise the transit system to all passersby. Furthermore, bus stops guide decision-making, working with the bus network to direct traffic down set corridors. With efficient and effective use of bus stop signage, transit agencies can reduce the burden of wayfinding on users at a basic level. The payback of improving access to information is difficult to parse, but the action is an important step towards developing a more user-friendly system; thereby improving the image of the transit agency and potentially helping to pull in new choice riders as well as retain existing ones.

The primary objective of this thesis is to facilitate the development and deployment of user information at bus stops, chiefly bus stop signage. To accomplish this task, user information elements were gleaned from the literature review. They supplied the framework for the execution of case studies, which were conducted in twenty-nine jurisdictions across the United States and Canada through site visits. In each jurisdiction, photographs of the different bus stop tiers that pertain to the area transit agency were taken. These photographs were then post-processed to identify the user information at each bus stop tier. The data was then input into constructed matrices to analyze and compare the frequency of use of each form of user information. The frequency distribution is the core component of the assessment and provides a snapshot of the state of the practice. The thesis concludes with recommendations for formulating design concepts of basic bus stop signs and further disseminating information throughout a bus system.

## 1.2 Structure of the Thesis

The thesis is structured into five chapters and an appendix. Chapter 2 examines existing literature, with discussions on wayfinding, the role of information, its delivery, and its different elements in transit systems. Chapter 3 communicates the methodology of the research, based on observational case studies. Chapter 4 states the findings of the observations to conclude the current state of the practice. The chapter includes examples of a select number of the case studies in which transit agencies displayed unique and/or innovative features. Chapter 5 engineers these findings into recommendations for transit agencies of different scales along with methods for

conceptualizing the information system. The chapter includes some sample designs that incorporate the recommendations for reference. An appendix is attached to the end of the thesis, which pulls together evaluations of all of the case studies with photographs to illustrate relevant elements.

# CHAPTER 2: LITERATURE REVIEW

Literature on the state of physical transit information and bus stop signs is relatively scarce. Information of this type may be held internally at transit agencies, but the Transit Cooperative Research Program (TCRP) is responsible for the bulk of the published literature. The limited literature may be attributed to an industry-wide assumption that all information elements are already known. If this assumption is true, the state of the art is not likely to move forward except through design and technological innovation. Yet, while research chases these revolutions, little remains known about state of the practice, the pragmatic actions that transit agencies have taken to improve their user information. Every transit agency is a laboratory, from which other agencies can pull significant knowledge to complete their own projects.

Given the limitations, this chapter presents some of the theoretical foundations of user information at bus stops: Wayfinding and navigational concepts, from which are derived the basic information needs of the user; the role and utility of information, which presents the goals of the provision of information; and, the delivery of information, which discusses user interactions with different information types. This background is followed by descriptions of the different information elements that were included in the research design of this thesis.

## 2.1 Wayfinding and Information Assessment

The transit trip model, which systematically links all of the segments that may take place in a uni- or multi-modal, non-chained trip between an origin and a destination, is the foundational theory that schematizes individual travel. These segments include:

1) Trip Planning
2) Origin to Transit Facility Entrance
3) Transit Facility Entrance to Boarding Platform
4) Boarding Platform to Vehicle
5) Vehicle En Route
6) Vehicle to Boarding Platform
7) Boarding Platform to Transit Facility Exit
8) Transit Facility Exit to Destination
9) Boarding Platform to Boarding Platform (Earnhart, 1996).

All segments but the first, trip planning, involve locomotion. Trip planning is vital to the model as it is the point at which the method of travel is determined. This reveals an underlying assumption built into the model—that users do not wander through a transit system aimlessly, but travel with a particular destination in mind. Given that assumption, the logic allows for the schematization of transit trips with decision points at which certain questions must be asked, either consciously or subconsciously, to proceed further (Wenzel, 2004). Those questions bear out the information that should

be provided at each decision point to guide users, regardless of prior experience, fluently from their origin to their destination.

Reframing the wayfinding process from a plan view schematic to a human-scale perspective is useful for recognizing the questions that people face at each stage of a trip. In this format, wayfinding becomes a cognitive process derived from orientation, route knowledge development, and expectancies based on prior experience (Denis, 1997; Tversky and Lee, 1998; Tversky, 2000).

For bus stops, the questions begin with orientation: Where am I? Where is my destination? Once oriented, questions consider mode options: What modes will take me there? Is the mode comfortable? Is it safe? Is it accessible? Route options can then be explored: Which routes go to my destination? Where do routes go from my location? How many transfers will I need to make? What is the fastest way to reach my destination? Then, questions move toward monetary and temporal utility: How much money will it cost? How much time will it take? How long will I need to wait until the next bus? Is the route reliable? How frequently should the bus pass? Not all of these questions are consciously considered—or even asked when the answer is pre-determined, nor are the questions weighed equally (Iseki and Taylor, 2010).

At the individual level, these questions are assessed in a relative manner that fits the needs of the respective user. At the aggregate level though, these questions are often assessed by monetizing the answers, with the assumption that users are rational and that they weigh the benefits and costs of all options. However, there is an

understanding that imperfect information exists in reality and, consequently, suboptimal decisions are prevalent. Imperfect information results from several circumstances, most notably, the scarcity of appropriate information accessible to a user and user perception, when different from reality (Lyons, 2006). Therefore, to alter suboptimal behavior, a transit agency should seek to improve the access to ample and clear user information resources.

Supplying the appropriate resources requires re-interpreting the questions that users ask at decision points and transforming them into information needs. TTI and NuStats International did just that and categorized the needs into two groups: pre-trip information needs and in-transit information needs. In the context of the earlier mentioned transit trip model, pre-trip information would include the decision point in segment 1, whereas in-transit information would include decision points in segments 2-9. Pre-trip information needs include the following:

- Location of the nearest bus stop
- Routes that travel to the desired destination and transfer locations
- Fare
- Time of departure and approximate duration of the trip

In-transit information needs include the following:

- At the departure point—Identification of the correct bus to board
- On the bus—Identification of bus stops for transfers or disembarking

- At transfer points—How to transfer to another route; cost, time limits, and restrictions; identification of the correct bus to board
- At the destination—Area geography and return trip information

Additionally, "supporting/confirming information" is emphasized as important supplemental information that should be supplied throughout the trip to offer reassurance to users (Higgins and Koppa, 1999). Other wayfinding research supports this report (Wenzel, 2004; Calori, 2007).

TTI and NuStats converted these information needs into infrastructure needs, or information aids. They grouped these aids into four tiers of which each require successively more intensive infrastructure. The first tier, the least intensive and the suggested minimum standard, includes a basic sign, bus sign board, and a customer service phone number. The following tiers build on each other, including all elements from the lower level tiers. The second tier includes a system map for distribution and a sign with a panel for a route map. The third tier includes a wall-mounted system map at shelters in addition to a sign with a panel for a schedule. The fourth and final tier includes an on-board system map, trailblazer signs that lead pedestrians to bus stops, and a route map with timetables for distribution. These tiers attempt to prioritize information by necessity and resource costs (Higgins and Koppa, 1999). Although the categories are different, the tiered approach is the same that this thesis has taken in its methodology.

The TTI and NuStats study attempts to roll together wayfinding dynamics with information needs in transit. Wayfinding is a complex field that brings together research from the fields of architecture, geography, psychology, and neuroscience. The field provides insight into the ways by which people read and interpret their environment. A basic understanding of these perspectives is essential to spatial information design. While it is not within the scope of this thesis to discuss the intricacies of this field, it is highly suggested that the reader digest some of the basic theories in this field. Ultimately, there are limitations as to the degree to which user information at bus stops, in isolation, can improve the legibility of transit systems, but it is a powerful tool with a host of ways in which it can aid users.

## 2.2 Role and Utility of Information

The role of information in transit systems is multifaceted. Information serves to make users aware of available trip options and it assists users in planning and executing trips (Lyons, 2006). Transit information is constructed as a customer service, centered on improving user experience. Yet, there is a quid pro quo to this customer service, an expectation that providing high levels of information benefits the transit agency as well. As Turnbull notes in TCRP Report 95 on Traveler Response to Transportation System Changes, “A primary goal of transit information and promotion activities is to increase ridership or net revenues, preferably both” (Turnbull, 2003). Transit agencies not only disseminate information to provide a customer service, but to attract new users as well as retain existing ones, encourage ridership shifts to more cost-effective services, build

support for specific initiatives and projects, and improve the image of public transportation (Turnbull, 2003).

Results as to the utility of the provision of information to achieve these goals remain unclear. In a 1995 survey of transit agency managers, Dobies found that only three out of twenty-one respondents listed increased ridership as a realized benefit from the installation of on-street information displays. However, the format of performance evaluation with "hard" data varied widely. For example, in 1994 Toronto Transit Commission (TTC) conducted a utility survey with likert scales and found that sixty-three percent of the sample used bus stop information. Of this group, forty-five percent found the information to be "somewhat useful" and thirty-six percent found the information to be "very useful" (Dobies, 1996). This methodology limits the ability to attribute ridership increases to information resources. On the other hand, Milwaukee County Transit System (MCTS), one of the three positive respondents, evaluated its project with follow-up surveys and found that "*three percent of the sample riders indicated they had started using the bus as a result of the new bus stop signs*" (Dobies, 1996). Furthermore, five percent of the sample riders stated that they used the bus more frequently (Dobies, 1996). These numbers, while small, represent significant increases in ridership, which, due to the methodology, could be tied to the expansion of user information.

Literature in this field is limited with few published surveys that tie system performance to the distribution of improved information resources. Surveys such as those

mentioned above are typically completed in-house by transit agencies that are making concerted investment in a signage project. Since signs have a lower capital cost associated with them when compared with other large-scale projects such as fixed-guideway construction, there is less internal and external scrutiny to evaluate the infrastructure to the same extent. Moreover, the information resources are difficult to isolate in general customer satisfaction surveys that routinely take place in transit agencies. These surveys often assess utility, similar to the TTC survey, which can provide useful information about the design of resources, particularly when the surveys focus on different elements of information resources, but they offer little opportunity to find valuable correlations between elements and ridership metrics (Higgins and Koppa, 1999; Turnbull, 2003; Cain, 2007).

## 2.3 Delivery of Information

The integrity of databases at transit agencies is crucial to supplying reliable user information. However, this information is of little import if it is not distributed. Delivery mechanisms range anywhere from paper timetables to dynamic LED signs. They are the chief access points by which users acquire knowledge of a transit system, its network and operations, outside of first-hand experience. User information delivery can be split into two groups by source: remote and local.

Remotely-sourced information, remote resources, relies on an intermediary to access information. This means that a user lacks direct access to information and thus depends on another entity to provide such information. Figures 2.1 and 2.2 illustrate simplified

paths by which these resources relay information. These resources have some unique advantages. They have a dynamic nature, with the potential to retrieve the most up-to-date information for a user. They can limit the supply of information to that which a user requests for consumption, which avoids information saturation that may otherwise cloud the user. They allow anyone to access information off-site for pre-planning, even those who have not yet visited a service area. Remote resources have potentially universal appeal and unparalleled opportunity for customization.

While access through an intermediary is the primary strength of remote resources, it is also the primary weakness. Remote resources break down when the intermediary is unavailable. Availability is determined at the access point, whether or not the user has the ability to retrieve information remotely, and at the intermediary point, whether or not the intermediary is available to retrieve information for the user. Even as many remote resources are considered as 'on-demand' resources, if one of these two points are unavailable, then resources cannot be accessed. For example, an access point availability problem occurs when a user does not have possession of the medium by which the resource is displayed—such as a smartphone when confronted with QR code-linked information. An intermediary point availability problem occurs when the intermediary is not in service, such as off-hours for a call center, an internet protocol (IP) network outage, or technical issues with electronic sign boards displaying real-time information. Remote resources trade potential unavailability for potential demand-responsive access.

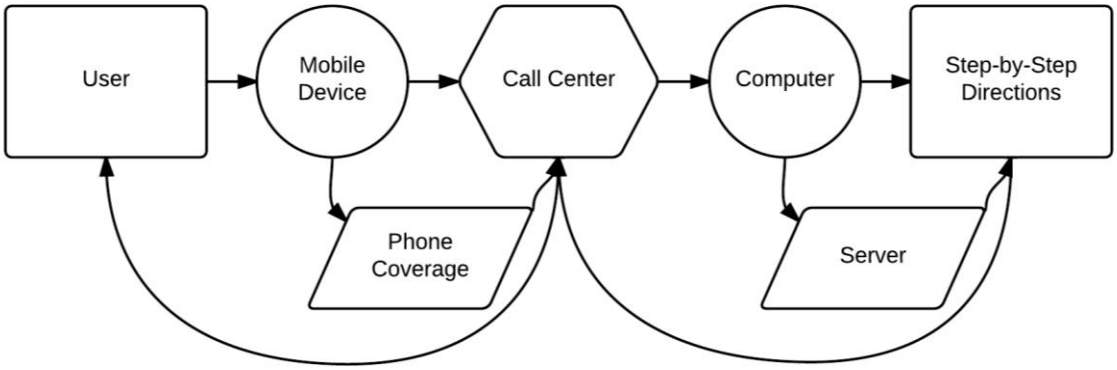



Figure 2.1. Relay of Information from a User to a Call Center

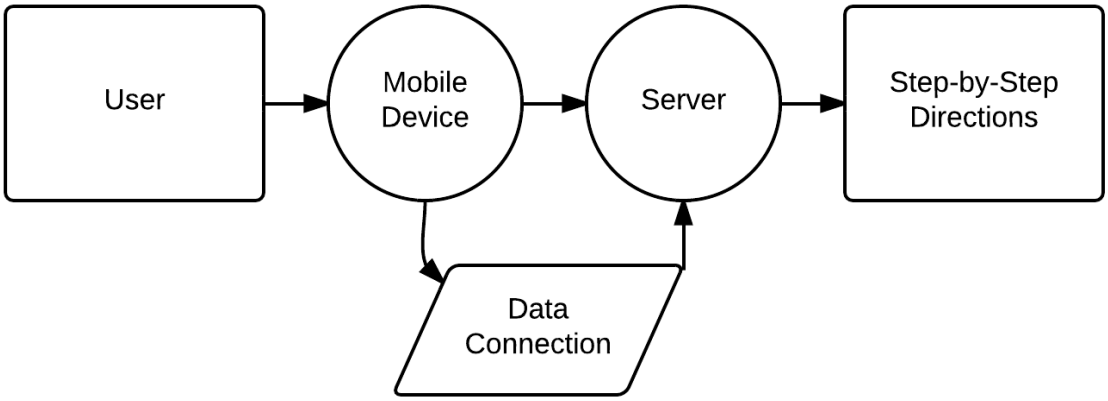



Figure 2.2. Relay of Information from a User to a Web Application

On the other hand, locally-sourced information, local resources, provides a user with direct access to information. Figure 2.3 illustrates a simplified path by which these resources relay information. These resources have some advantages of their own. They are stable resources that remain the most prevalent way by which transit agencies distribute information. This means that most users are familiar with the different elements that make up local resources, such as signs, schedules, and maps. Local resources are available, at the least, during operating times and to all users. They can

be found on site at bus stops and en route for reference and confirmation, regardless of time of day, week, month, or year and without regard for the demographics of a user. This last quality is the most important as it presents a claim to universality of access point availability.

The weaknesses of local resources are generally solved through remote resources, specifically the lack of dynamic information. However, the greatest weakness is sourced in one of its greatest assets—its ubiquity. This makes it difficult for transit agencies with limited resources to maintain information so that it remains up-to-date. If local resources are tailored too closely to a specific schedule, route network, etc. then even minor tweaks that take place during routine service changes may require considerable funds, time, and labor to alter those resources. The static nature of local resources makes them relatively inflexible and somewhat costly to update. This attribute also makes transit agencies with uncertain stability tentative to display specific information that would be helpful to users, limiting the potential of these resources. Local resources trade dynamism for basic access and availability.

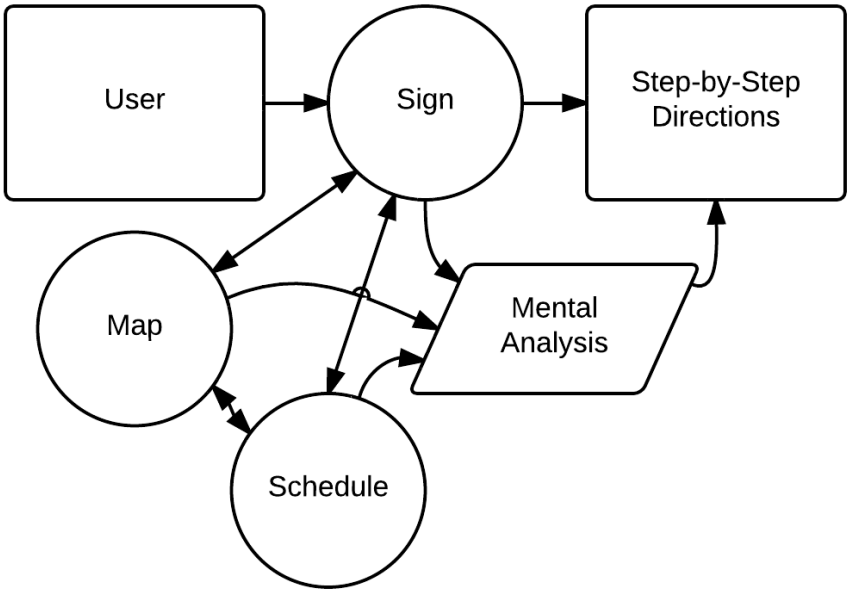



Figure 2.3. Relay of Information from a User to a Local Resource

While there are many different elements of local resources, bus stop signs have the most advantages, as they are ideally suited to aiding users at decision points. They also provide a support network that offers confirming information to users (Higgins and Koppa, 1999). With reference back to the transit trip model, the segments from the transit facility entrance to the vehicle, the vehicle to the transit facility exit, and between boarding platforms are decision points at which signs have a prominent role in the guidance of users. Moreover, when designed efficiently and effectively, bus stop signs offer confirmation as the vehicle is en route. Supplemental displays with other elements are typically needed for trip planning and reaching the destination from the transit facility exit. Remarkably though, information on all segments except that from an origin to the transit facility entrance can be provided at a single bus stop site.

## 2.4 Information Elements

There are a number of different information elements that exist at bus stops. In 1983, APTA developed a bus stop hierarchy with an extensive list of twenty-one recommended elements in its *Marketing On-Street Information* manual. Table 2.1 displays this list in an illustration of its bus stop hierarchy concept.

Table 2.1. APTA Bus Stop Hierarchy Concept with List of Information Elements (Dobies, 1996).

| Elements of the Transit Stop Sign | | | | |
|---|---|---|---|---|
| Elements | Type of Bus Stop | | | |
| | Single Route | Multiple Route | High Density Route | Specialized Route |
| Stop Identification | | | | |
| Mode Identification | | | | |
| Logo | | | | |
| Route Destination | | | | |
| Direction | | | | |
| Service Frequency | | | | |
| Route Map | | | | |
| Stop Timetable | | | | |
| Route Timetable | | | | |
| Transit Information Telephone Number | | | | |
| System Map | | | | |
| Fare Information | | | | |
| General Passenger Information | | | | |
| Accessibility Information | | | | |
| Pedestrian Guides | | | | |
| Local Area Map | | | | |
| Special Services | | | | |
| Transfer Points | | | | |
| Zone Identification | | | | |
| Major Destinations | | | | |

The figure presents elements in the rows with a suggested hierarchy based on the importance of stops, in which more elements would be added at bus stops with progressively higher levels of importance, in the columns. This thesis builds off of this concept to create a concept that is relevant to today, complete with new elements that did not exist at the time that the original had been drafted nearly twenty years ago. The remainder of this section describes bus stop information types and each of their respective elements that are included in this thesis.

### *2.4.1 Identification*

#### *Stop ID*

The stop ID is the unique strand of characters that links a bus stop to a database. The stop ID allows other data to be cleanly and automatically associated to particular bus stops by way of database management software packages. On its face, it has no value to an end-user; however, the various data links to the Stop ID allow intermediaries such as web applications to access location-specific information that the end-user can consume.

### *2.4.2 Location Information*

#### *Stop Location*

The stop location includes the “on street” and the “at street”. The on street is the street on which the stop exists, whereas the at street is the nearest intersecting street. When the stop occurs at a midblock section, the street address may be substituted for the at street when the nearest intersecting street is distant. Stop locations are redundant with

street signs at corners and addresses on buildings. However, the element allows a user to confirm a location without searching for the respective street signs. This is particularly useful when street signs and visibility are limited.

#### *Bay Locations*

Bay locations include a bus bay map, a compact transit corridor map, or a sign with a character that identifies a designated bay or corridor stop. Bus bays are typically found at transit centers and park-n-rides, while compact transit corridors are typically found in central business districts (CBDs), where routes are concentrated and space is limited. Bay locations provide a user with a quick and simple spatial reference for finding a specific stop in an area that often saturates the user with visual clutter.

#### *"You Are Here" Map*

The "You Are Here" map shows a map of the surrounding area with a marker that identifies the current location of the user on the map. This marker helps the user to orient themselves. Moreover, it contextualizes the stop with reference to the neighborhood.

### *2.4.3 Route Information*

#### *Route Numbers/ Name*

The route number and/or name identifies the routes that serve a bus stop. This allows a user to confirm that they are at the correct location when waiting for a bus.

### *Direction*

The route direction identifies the primary heading of a route trip. Signs with this information for a basic line route will show a heading on one side of the street and the opposite heading on the other side of the street. In a grid street network, this is fairly straightforward using cardinal directions. In a complex network, where cardinal headings may not be immediately apparent, relative headings such as “Inbound” and “Outbound” may be used. The direction heading allows a user to confirm that they are on the appropriate side of the street for those routes with paired stops.

### *Route Map*

The route map is either a geographic or diagrammatic map that is limited only to the route to which it pertains. This map may have points of interest on it as well as route transfer points. It may or may not display the current location of the user. The route map assists a user with route comprehension for planning upcoming trip segments.

### *Destination(s)*

The destination may be the end-of-line where a route trip terminates or it may be one or several major points of interest that a route trip serves. The listed destinations should only include those between the respective stop and the route end-of-line. Other destinations in the opposing route direction should not be listed unless they are a part of a route map. The destination allows a user to confirm that they are on the appropriate side of the street for those routes with paired stops. It also allows a user to associate routes with destinations, which potentially improves network comprehension.

#### *Connecting Routes*

Connecting routes are found as parts of a route map with labeled transfer points or as a sign that directs users to a nearby bus stop with intersecting routes. The connecting routes identification helps users to plan and complete transfers seamlessly.

### *2.4.4 Scheduling Information*

#### *Days/ Hours of Operation*

The days and/or hours of operation display the times for which routes are in service. This information is helpful for peak-only, late-night, and other limited services. This allows a user to develop expectations for service when the user does not have access to a schedule. It also helps a user to plan trips that take place in the early morning or late evening.

#### *Route Schedule*

The route schedule is a display of the times at which a route is expected to arrive at a bus stop. It may be stop-specific or it may be route-specific with time points. The route schedule allows a user to plan around the bus schedule to minimize wait times.

The stop-specific schedule simplifies the more complete route-specific schedule by only enumerating times relevant to an individual bus stop. While this method is more easily consumed by an end-user, it also leaves out other potentially useful information such as expected arrival times at destinations on the route. A stop-specific route map with approximate travel times to time points elsewhere on the route can mitigate this issue by allowing a user to add the travel time to the departure time to estimate the arrival

time at a destination. The schedule can be simplified when the headway is a multiple of 60 (eg 10, 12, 15, 20, 30, 60) since the bus will be scheduled to stop at a location at the same times each hour.

### *Frequency*

The frequency is the number of buses that arrive at a stop per hour. This can be readily converted into, and is more commonly expressed as, headway, which is the amount of time from when one bus departs a stop and the next bus arrives. Frequency offers users an indication of how long they might expect to wait if they miss a bus. Routes with high frequency (at minimum four buses per hour, but recommended at five or more buses per hour) can replace schedule information with a frequency notation.

### *Scheduled Next Bus*

The scheduled next bus time refers to a link to remote resources which provide the stop-specific next bus arrival time. This can be accessed through electronic signs, text messaging, web applications, QR codes, or calls. This allows a user to set expectations when waiting for a bus and it allows a user to time their arrivals accordingly.

### *Real-Time Next Bus*

The real-time next bus time refers to a link to remote resources which provide the stop-specific next bus arrival time. This can be accessed through electronic signs, text messaging, web applications, QR codes, or calls. This allows a user to set expectations when waiting for a bus and it allows a user to time their arrivals accordingly. This is particularly helpful on routes with poor on-time performance.

### *2.4.5 System Information*

#### *System Map*

The system map is a map of the entire transit network. This allows a user to plan the entirety of a trip, complete with all connections. It also allows a user to check if origins or destinations have acceptable transit coverage.

#### *POI Guide*

The points of interest (POIs) guide lists points of interest and sometimes attaches descriptions. It also identifies POI locations on a map. These are often directed toward tourists, but they also can help regular users to orient themselves.

### *2.4.6 General Information*

#### *Fare Information*

Fare information includes the cost of a ride including an explanation of any complexities such as variable fares, acceptable payment formats, tickets or passes that are available for purchase, etc. This helps a user to calculate expected trip costs and it provides a new user with an upfront expectation of how to pay for a ride.

#### *Safety Information*

Safety information lists helpline numbers or general information regarding public safety. The phone numbers typically reach transit or local police departments. Furthermore, safety information may notify a user of protocols to follow if the user witnesses a potential crime or needs assistance.

#### *Public Message Board*

The public message board is a blank board made of a material such as cork that allows the public to post information freely. This allows for dissemination of non-transit-related information. It also provides space for a transit agency to post area-relevant information such as notices for public meetings.

#### *Revision Date*

The revision date is the date, usually month and year, in which the provided information was last modified. While the date does not allow for confirmation that information is current, it can connote to a user the probability that the information is up-to-date.

#### *Website*

The website url connects a user to the transit agency web page through remote resources on a web-connected device at home, en route, or anywhere else with a data connection. The utility of a website to a user is determined by the information that is provided on the website itself. It has the potential to provide the user with all data that the transit agency has collected and published.

### *2.4.7 Contact Information*

#### *Phone Number*

The phone number connects a user to a call center provided by the transit agency to take questions, suggestions, comments, complaints, etc. This is a direct customer-service component of a transit agency. When input is tracked, it provides the transit agency with a record to review frequently mentioned items as well as follow-up with

callers to resolve issues and assess satisfaction. This number should include the *area code*.

#### *TTY/TDD*

TTY, teletypewriter, or TDD, telecommunications device for the deaf provides a mobile communication line for the deaf. It connects a deaf user to a call center provided by the transit agency to take questions, suggestions, comments, complaints, etc. This is a direct customer-service component of a transit agency. When input is tracked, it provides the transit agency with a record to review frequently mentioned items as well as follow-up with callers to resolve issues and assess satisfaction.

### *2.4.8 Accessibility Information*

#### *Wheelchair Accessibility*

Wheelchair accessibility information has differing functions. It may be stop-specific, route-specific, or system-wide. Stop-specific wheelchair accessibility information refers to the accessibility of the site and its pad. Route-specific wheelchair accessibility information refers to the accessibility of the vehicles that serve the route. System-wide wheelchair accessibility generally refers to a system in which all vehicles have lifts or plates to allow for wheelchair boarding.

#### *Bicycle Accessibility*

Bicycle accessibility information is route-specific or system-wide and refers to the existence of front-mounted racks (FMRs) on buses to allow for the storage of bicycles. This functions as an advertisement for bike-n-bus programs.

Trip-making is a travel-based form of decision-making. The action takes into account various forms of information to prompt a choice. In public transit, as in many fields, the goal of information is to provide a foundation on which users can make effective and efficient decisions on a consistent basis. To achieve this goal, transit agencies must offer both *clear* and *comprehensive* information at appropriate decision points for their respective users. This investment not only delivers an improved customer experience in which more people can make independent decisions with greater certainty, but also it can attract non-users by removing former barriers. Transit information comes in many different forms and covers a variety of topics, all of which may be important to any individual user. While meeting all possible needs or wants may not be attainable, an ideal information system should *at least* meet the expectations of most users. These expectations are built from prior experiences in public transit systems. To develop an understanding of what these expectations are likely to be, one must examine the state of the practice.

# CHAPTER 3: METHODOLOGY

This chapter goes over the approach of the thesis with site selection, data collection, and processing. Twenty-nine site visits for case studies of transit agencies across the United States and Canada were conducted. Each transit agency was selected based on an initial criteria set up to filter out smaller agencies and provide for geographic distribution. In the respective jurisdictions of each transit agency, photographs of the different bus stop tiers were taken. These photographs were then post-processed and analyzed to identify the user information at each bus stop tier. The collected data were then input into constructed matrices to analyze and compare the frequency of use of each form of user information. Subsets of the designed matrices along with accompanying photos are shown in this section. Aggregated matrices and the frequency distributions of each user information element are shown in the following chapter in addition to unique elements found at different agencies.

## 3.1 Agency Site Selection

Four Canadian transit agencies and twenty-five American transit agencies were selected from the most populous urban areas. Additionally, selections were made to represent a geographic distribution across the continent. While an urban area may have multiple transit agencies, only the largest of those agencies by bus ridership was selected for observation. The decision to limit the study to this group was made because large agencies must contend with issues of scale, whereby substantial resources are needed to make even minor changes to the information system.

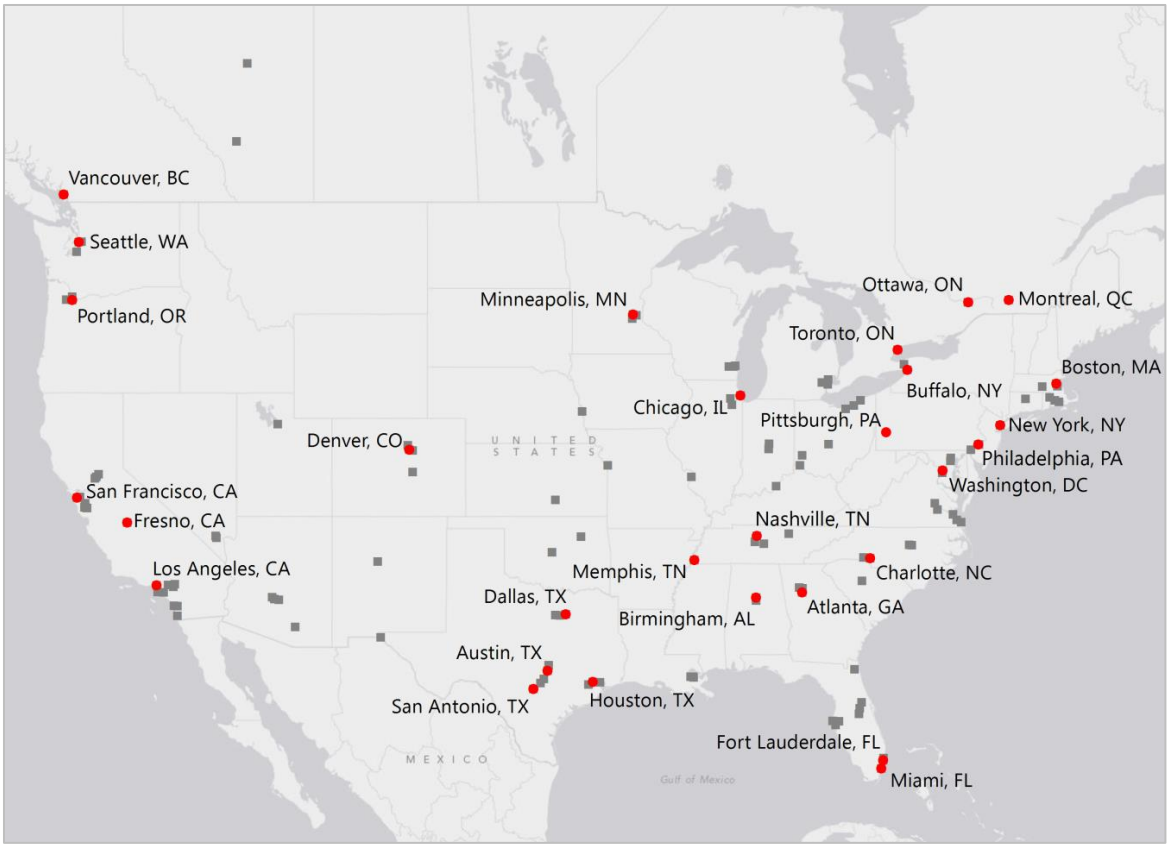



Figure 3.1. Map of Eligible Sites (grey box) and Selected Sites (red circle) in US and Canada

Table 3.1. Selected Agency Sites (APTA, 2012)

| Selected Agency Sites | | | |
|---|---|---|---|
| **Acronym or Abbreviation** | **Agency** | **Urban Area, State/ Prov.** | **Avg Wkdy Bus Ridership** |
| MARTA | Metropolitan Atlanta Rapid Transit Authority | Atlanta, GA | 193,100 |
| Capital Metro | Capital Metropolitan Transit Authority | Austin, TX | 111,700 |
| BJCTA | Birmingham-Jefferson County Transit Authority | Birmingham, AL | 10,200 |
| MBTA | Massachusetts Bay Transportation Authority | Boston, MA | 373,300 |
| NFTA | Niagara Frontier Transportation Authority | Buffalo, NY | 79,100 |
| CATS | Charlotte Area Transit System | Charlotte, NC | 69,000 |
| CTA | Chicago Transit Authority | Chicago, IL | 983,500 |
| DART | Dallas Area Rapid Transit | Dallas, TX | 133,400 |
| RTD | Regional Transportation District | Denver, CO | 207,300 |
| BCT | Broward County Transit | Ft Lauderdale, FL | 129,700 |
| FAX | Fresno Area Express | Fresno, CA | 35,500 |
| METRO | Metropolitan Transit Authority of Harris County | Houston, TX | 219,300 |
| LACMTA | Los Angeles County Metropolitan Transportation Authority | Los Angeles, CA | 1,127,200 |
| MATA | Memphis Area Transit Authority | Memphis, TN | 32,500 |
| MDT | Miami-Dade Transit | Miami, FL | 244,000 |
| Metro Transit | Metro Transit | Minneapolis, MN | 230,900 |
| STM | Société de Transport de Motntréal | Montreal, QC | 671,300 |
| Nashville MTA | Nashville Metropolitan Transit Authority | Nashville, TN | 32,400 |
| NYCT | New York City Transit Authority | New York, NY | 2,466,200 |
| OC Transpo | Ottawa-Carleton Regional Transit Commission | Ottawa, ON | 431,800 |
| SEPTA | Southeastern Pennsylvania Transportation Authority | Philadelphia, PA | 487,800 |
| Port Authority | Port Authority of Allegheny County | Pittsburgh, PA | 181,400 |
| TriMet | Tri-County Metropolitan Transportation District of Oregon | Portland, OR | 188,600 |
| VIA | VIA Metropolitan Transit | San Antonio, TX | 144,800 |

| Selected Agency Sites *(cont.)* | | | |
|---|---|---|---|
| **Acronym or Abbreviation** | **Agency** | **Urban Area, State/ Prov.** | **Avg Wkdy Bus Ridership** |
| MUNI | San Francisco Municipal Transportation Agency | San Francisco, CA | 297,700 |
| King County Metro | King County Metro Transit | Seattle, WA | 304,700 |
| TTC | Toronto Transit Commission | Toronto, ON | 1,355,400 |
| TransLink | South Coast British Columbia Transportation Authority | Vancouver, BC | 578,300 |
| WMATA | Washington Metropolitan Area Transit Authority | Washington, DC | 447,700 |

## 3.2 Bus Stop Site Selection

Sites within each of the transit agencies were selected based on expectations and, occasionally, happenstance. Bus stops were broken down into tiers, which provide different levels of information. Figure 3.2 presents an example of each tier. The four tiers identified include the following:

1) Low Information Bus Stop – These stops are the most basic bus stops that exist in the system and typically include just a bus stop sign attached to a signpost or strapped to a utility pole.

2) High Information Bus Stop – These stops are more advanced than the low information bus stops and typically include a signpost panel that holds additional information. This tier does not exist at every transit agency as an agency may utilize just one sign type.

3) Shelter Bus Stop – These stops have shelters that not only provide protection from the elements for users, but also often have large panels to display more detailed

information than is possible in signpost panels. This tier may not always include more information than found at signposts, as shelters are often contracted out to advertisement agencies, who may or may not allow/include panels for user information.

4) Transit Center/ Station Bus Stop – These stops are the most advanced bus stops with the most amenities as well as significant space to present user information. This tier includes multi-modal transfer stations, bus stations, as well as park-n-rides.


Figure 3.2. Samples of Each Bus Stop Tier – Low Information- San Antonio, TX (top-left); High Information- Boston, MA (top-right); Shelter- Toronto, ON (bottom-left); Transit Center/ Station- Denver, CO (bottom-right)

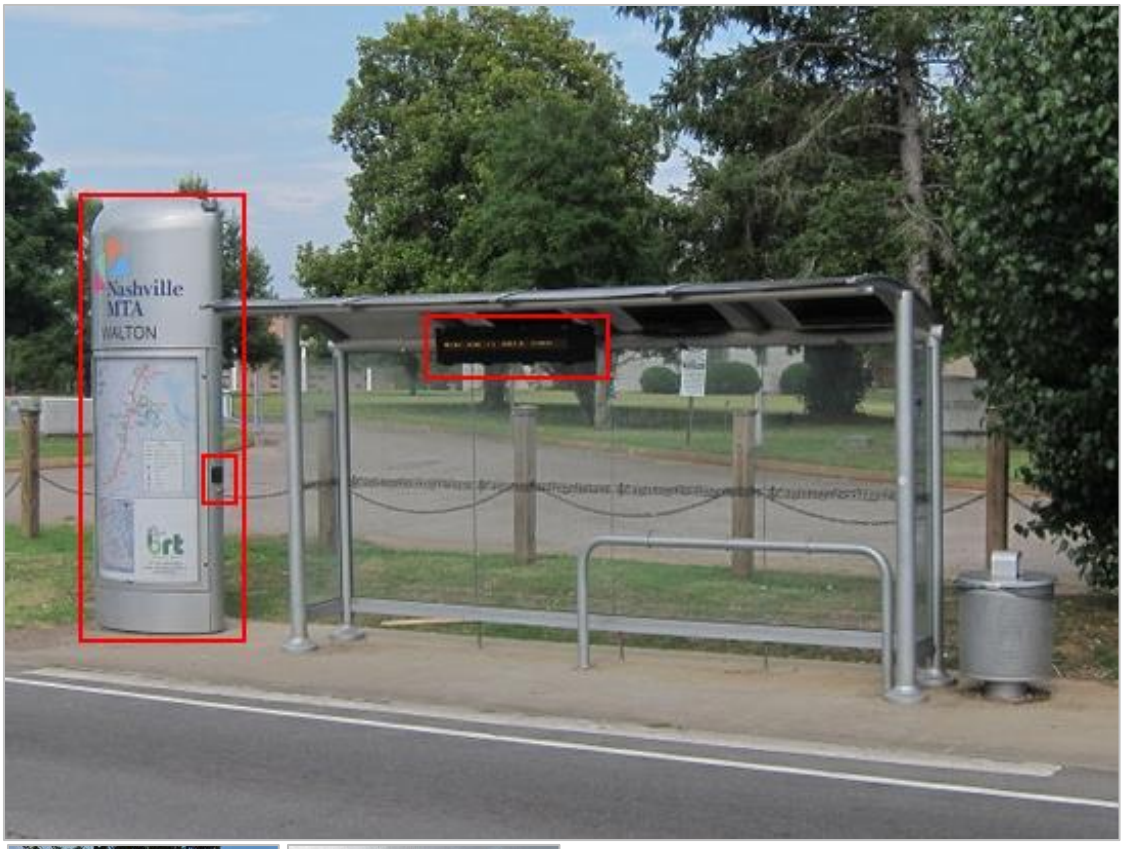
In order to collect information for each of the tiers, the system map was collected at each agency site to consider the makeup of the respective transit network. Low information bus stops could be found throughout the network outside of the central business district (CBD) and did not require much consideration. High information stops could often be found along the most frequent bus routes, along routes with special service types (non-local), or in the CBD. Shelter bus stops had the greatest amount of variation as there were often multiple generations of shelters. The newest shelters were surveyed, unless unique information could be found at older shelters. Shelters could be found in the CBD at high automobile traffic intersections, where advertisers would be likely to place them as well as at high pedestrian traffic intersections, which alludes to stops with high ridership, where transit agencies and local jurisdictions would be likely to place them. Finally, transit center/ station bus stops could be readily found using the system map. The most advanced stations were often found at the main transit center in the CBD, but occasionally at the most recently constructed transit center, which was not always known.

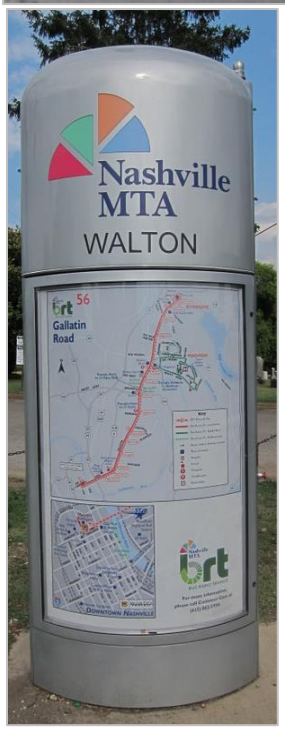
When variation of user information existed within any single tier, such as the shelter bus stops, all of the unique data was collected. This data was then aggregated in the post-processing stage.

## 3.3 Photograph Collection

Site visits were conducted between March 2011 and December 2012. Photographs were taken at each of the applicable bus stop tiers of each transit agency. Photographs

include the entirety of a bus stop site, as well as close-ups of different elements that could not be adequately captured from a distance for proper legibility in the post-processing stage. Figure 3.3 shows subsets of these images. In order to ensure that all elements found on site visits were collected, multiple images were taken of the same bus stop tier if there was any uncertainty as to whether or not an element had previously been captured.


Nashville
MTA
WALTON
brt


Nashville
MTA
WALTON
brt 56
Gallatin
Road
brt


PUSH TO
SIGNAL
BUS
TO STOP


Sun Jun 17 2012 4:44

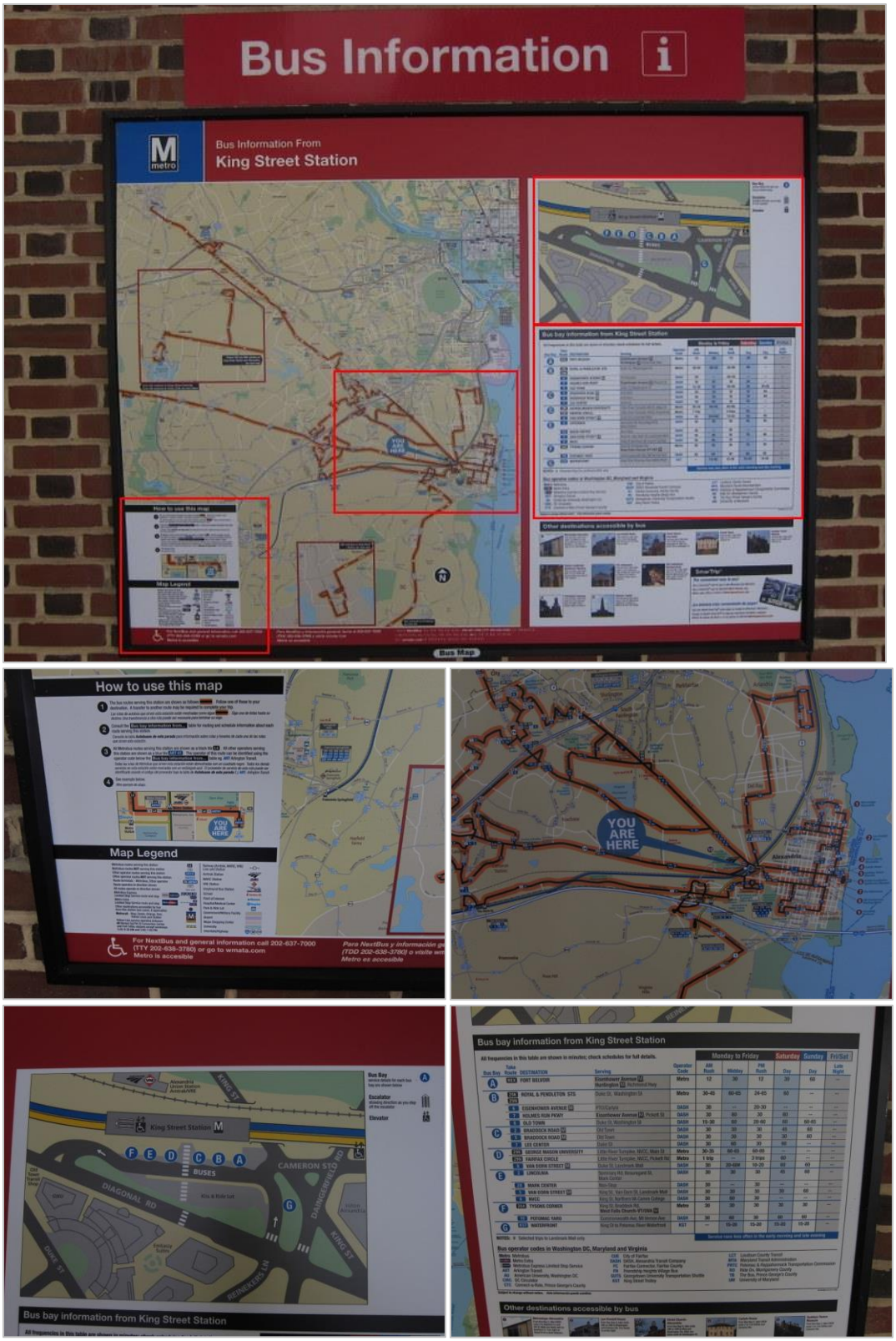



Figure 3.3. Two Subsets of Bus Stop Images at Different Ranges where Greater Detail is Necessary to Read and Post-process All Elements

## 3.4 Post-Processing

Once site visits were complete, the photographs were uploaded and post-processed for legibility. Then, each image was inspected to log each user information element found into matrices. The matrices were developed as the primary record sheets for each transit agency. Each matrix represented a different tier to allow for direct comparisons between the transit agencies and to assess the prevalence of the application of each information element within each tier. After the matrices were filled out, they were reformatted to merge the tiers by transit agency so that a single matrix could show all of the results of an individual agency as well. This shows the entire information system of a transit agency in its own context. Figure 3.4 illustrates this method with a model.

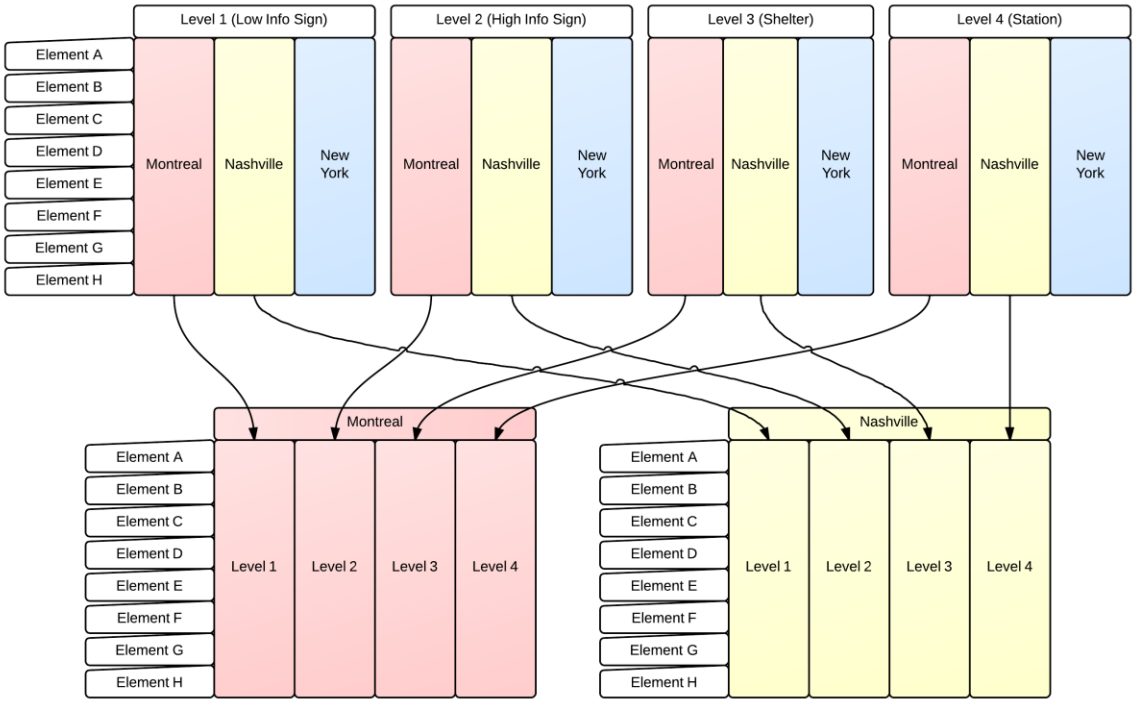



Figure 3.4. Model of the Development of the Matrices by Tier and by Agency

# CHAPTER 4: FINDINGS

This chapter displays the results of the post-processing and provides a discussion of the results. These results include the developed matrices as well as the frequency distribution tables for the different user information elements. The frequency distribution tables describe the penetration of each element into the aggregate market of agency sites and allow for an assessment of the state of the practice based on the transit agencies included in this study.

## 4.1 Matrices

The data collection and post-processing culminated in four matrices, Table 4.1, Table 4.2, Table 4.3, and Table 4.4; each of which represents a different tier. Colors were used to classify the presence of an information element. The classification system is as follows:

Green indicates that the information element is present throughout a significant segment of the system, if not the entire system at the specified tier.

Yellow indicates that the information element is present, but to a limited subset of the tier—the labels inside the yellow boxes identify the limitation.

Red indicates that the information element is not present in the system.

Purple indicates that the information element is present, but in the form of pamphlets, which may be picked up at the specified tier without the need to request such material from personnel. This qualification for free access without

request was used because personnel are typically not available at all times when buses are in service.

Blue indicates an incomplete site visit to a particular tier. This is based on examination of system maps and is usually reserved for visits in which the researcher did not collect data from a park-n-ride-like facility, even if a station/ transit center elsewhere in the locality was covered. While the information element was not observed in the tier, it cannot be stated with certainty that the element does not exist there.

Table 4.1. Tier 1 (Low Information Sign) Matrix

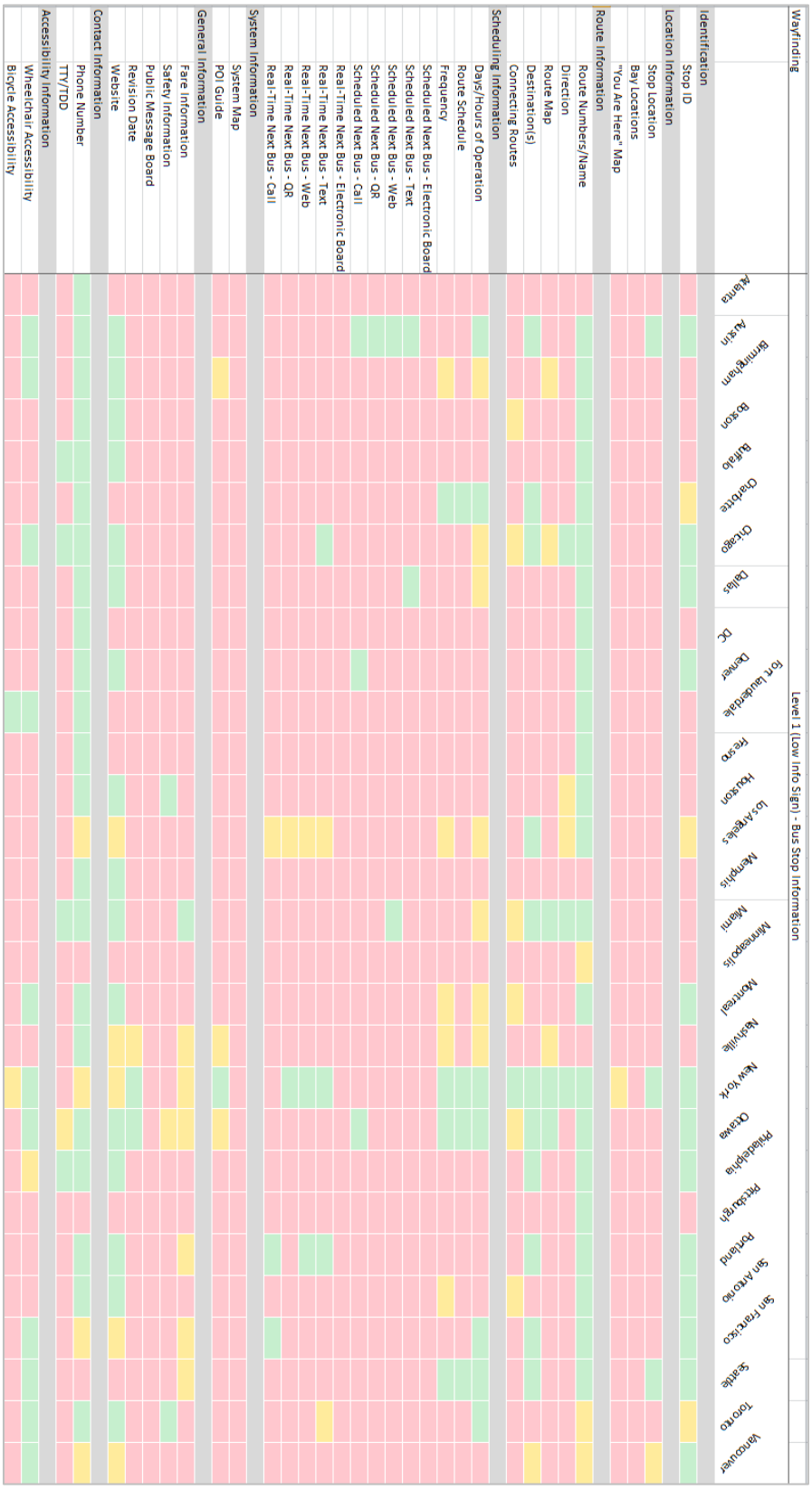


Table 4.2. Tier 2 (High Information Sign) Matrix

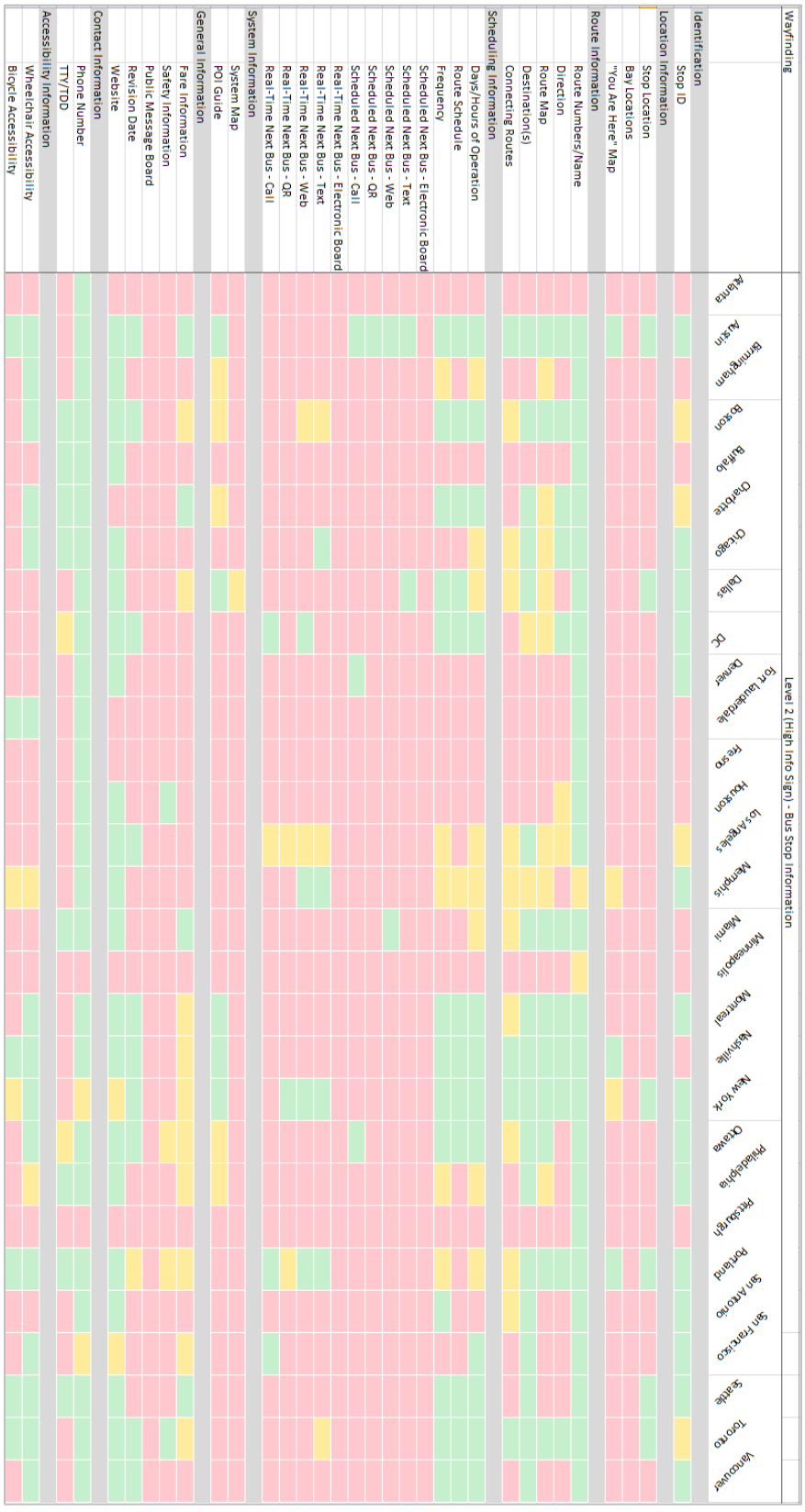


Table 4.3. Tier 3 (Shelter) Matrix

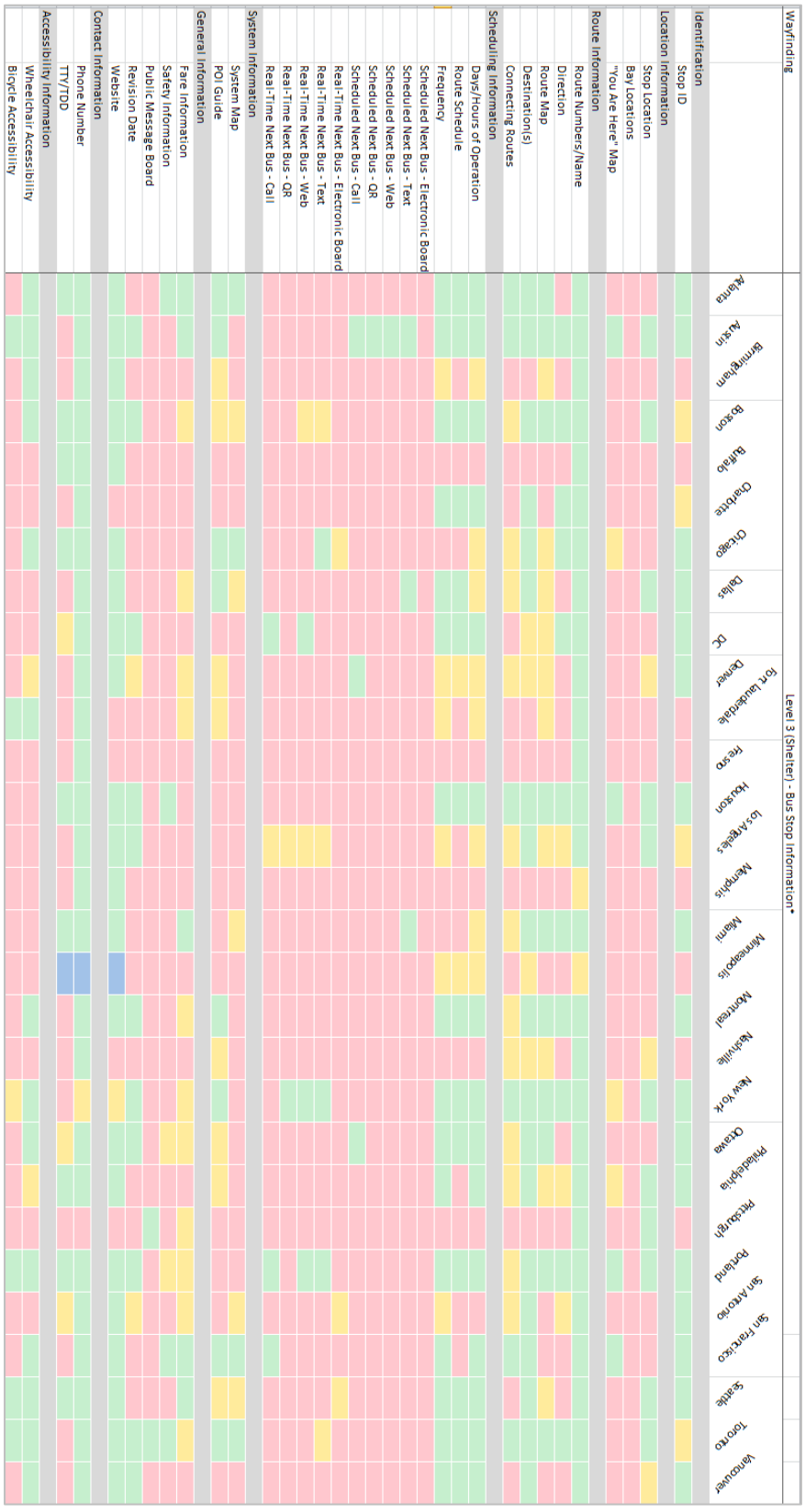
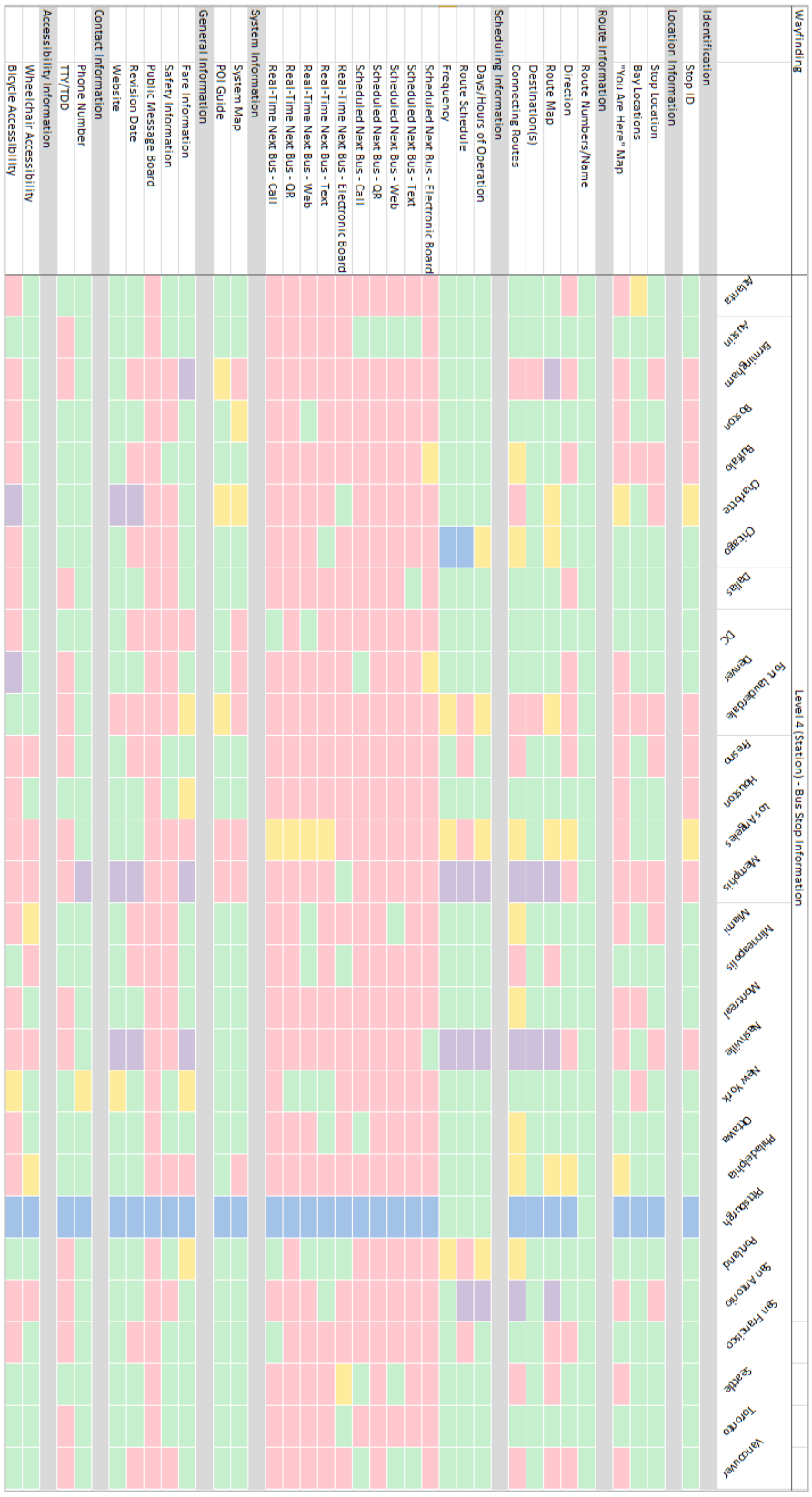


Table 4.4. Tier 4 (Transit Center/ Station) Matrix



## 4.2 Agency Penetration and the State of the Practice

An objective of this thesis was to ascertain the state of the practice to better understand the implementation level at which the American and Canadian bus stop user information infrastructure exists. To determine the overall state, the colors in the matrices were converted into digits: green (extensive presence) equates to 1, yellow (limited presence) equates to 0.50, purple (pamphlet presence) equates to 0.25, and red (no presence) equates to 0. Each information element in the matrices was then summed up by tier, the results of which are found under "Cases" in Table 4.5. These sums were divided by the number of observed agency sites and converted into a percentage, the results of which are found under "Penetration" in Table 4.5. The penetration rates indicate the state of the practice.

Table 4.5. Penetration of User Information Elements at Sites

| Identification | | Low Info | High Info | Shelter | Ctr-Stn | Low Info | High Info | Shelter | Ctr-Stn |
|---|---|---|---|---|---|---|---|---|---|
| | Stop ID | 14.5 | 17 | 19 | 19 | 50% | 59% | 66% | 68% |
| Location Information | | | | | | | | | |
| | Stop Location | 3.5 | 6 | 12.5 | 19 | 12% | 21% | 43% | 68% |
| | Bay Locations | 0 | 0 | 0 | 22.5 | 0% | 0% | 0% | 80% |
| | "You Are Here" Map | 0.5 | 4 | 5 | 11 | 2% | 14% | 17% | 41% |
| Route Information | | | | | | | | | |
| | Route Numbers/Name | 24.5 | 26 | 28 | 29 | 84% | 90% | 97% | 100% |
| | Direction | 4 | 12 | 12.5 | 16 | 14% | 41% | 43% | 57% |
| | Route Map | 4.5 | 13 | 15 | 18.5 | 16% | 45% | 52% | 66% |
| | Destination(s) | 11.5 | 19 | 21 | 24.5 | 40% | 66% | 72% | 88% |
| | Connecting Routes | 4 | 9 | 12 | 14.75 | 14% | 31% | 41% | 53% |
| Scheduling Information | | | | | | | | | |
| | Days/Hours of Operation | 10 | 16 | 19 | 24.75 | 34% | 55% | 66% | 85% |
| | Route Schedule | 4 | 12.5 | 15 | 20.75 | 14% | 43% | 52% | 74% |
| | Frequency | 6.5 | 15.5 | 19 | 25 | 22% | 53% | 66% | 89% |
| | Scheduled Next Bus - Electronic Board | 0 | 0 | 0 | 2 | 0% | 0% | 0% | 7% |
| | Scheduled Next Bus - Text | 2 | 2 | 3 | 3 | 7% | 7% | 10% | 11% |
| | Scheduled Next Bus - Web | 2 | 2 | 1 | 4 | 7% | 7% | 3% | 14% |
| | Scheduled Next Bus - QR | 1 | 1 | 1 | 1 | 3% | 3% | 3% | 4% |
| | Scheduled Next Bus - Call | 3 | 3 | 3 | 5 | 10% | 10% | 10% | 18% |
| | Real-Time Next Bus - Electronic Board | 0 | 0 | 1.5 | 5.5 | 0% | 0% | 5% | 20% |
| | Real-Time Next Bus - Text | 4 | 5.5 | 4.5 | 5.5 | 14% | 19% | 16% | 20% |
| | Real-Time Next Bus - Web | 2.5 | 5 | 4 | 6.5 | 9% | 17% | 14% | 23% |
| | Real-Time Next Bus - QR | 1.5 | 2 | 1.5 | 1.5 | 5% | 7% | 5% | 5% |
| | Real-Time Next Bus - Call | 2.5 | 3.5 | 3.5 | 3.5 | 9% | 12% | 12% | 13% |
| System Information | | | | | | | | | |
| | System Map | 0 | 0.5 | 6.5 | 20 | 0% | 2% | 22% | 71% |
| | POI Guide | 2.5 | 7.5 | 12 | 24.5 | 9% | 26% | 41% | 88% |
| General Information | | | | | | | | | |
| | Fare Information | 4 | 0 | 10.5 | 20.75 | 14% | 0% | 36% | 74% |
| | Safety Information | 2.5 | 3 | 5 | 11 | 9% | 10% | 17% | 39% |
| | Public Message Board | 0 | 0 | 2 | 0 | 0% | 0% | 7% | 0% |
| | Revision Date | 2.5 | 10.5 | 12 | 15.75 | 9% | 36% | 43% | 56% |
| | Website | 18.5 | 22 | 22.5 | 24.25 | 64% | 76% | 80% | 87% |
| Contact Information | | | | | | | | | |
| | Phone Number | 24 | 26 | 26.5 | 26.75 | 83% | 90% | 95% | 96% |
| | TTY/TDD | 4.5 | 9 | 10.5 | 13 | 16% | 31% | 36% | 46% |
| Accessibility Information | | | | | | | | | |
| | Wheelchair Accessibility | 11.5 | 16 | 15 | 21 | 40% | 55% | 52% | 75% |
| | Bicycle Accessibility | 1.5 | 7 | 5.5 | 8 | 5% | 24% | 19% | 29% |

Those elements with penetration rates where fifty percent or more of the agency sites exhibited their use are considered common. The common elements by tier are highlighted in yellow in Table 4.5. A user could reasonably expect to see these elements in any large transit agency in the United States and Canada. Put in another way, the table presents minimum information standards for agencies to be in line with peers and to meet those user expectations. For instance, at the low information sign tier, agencies

should present *at least* the route numbers, website, and a customer service number for users to call for more information. More than four out of every five transit agencies display route numbers or route names and a customer service number on their most basic bus stop signs. Furthermore, nearly two out of every three transit agencies post their websites for users on these signs. Meanwhile, only one agency had a QR code at the low information tier. Although a QR code is very useful to some users, it should by no means be an expectation to find such a feature at this level. On the other hand, agencies should present, and users should expect, nearly every non-remote information resource at the transit center/ station tier.

A noticeable pattern in these results is that once an element crosses the threshold at a tier, higher level tiers continue to incorporate that element. While graduated improvement is typical for common elements, contraction in the number of visible elements sometimes occurs for uncommon elements. This contraction takes place most often between the high information stop tier and the shelter stop tier when an agency does not choose to utilize their high information bus stop infrastructure at shelters, instead reverting back to low level information with an addition such as a system map or perhaps only non-utilitarian advertisements put on display in the shelter.

The one quirk in Table 4.5 is the stop ID information element, which is not useful by itself; rather, it is dependent on remote resources to derive its utility. While common, they are unnecessary unless the agency plans on leveraging the stop ID for remote resources. This suggests that most agencies may already incorporate remote resources;

however, as the table shows, many fail to relay information as to how a user may connect with these resources, relying instead on word of mouth.

### 4.3 Innovative Elements

A number of the agencies took unique approaches to providing different pieces of user information. While these approaches might be construed as best practices, they may only be practicable for a limited number of transit agencies in similar situations or with similarly designed user information displays and/or signage. A solution that works as a panacea is rare as capital and labor costs associated with information distribution such as signage vary widely between markets. For these reasons, this section is labeled "Innovative Elements" rather than "Best Practices". Nevertheless, this section offers transit managers, decision-makers, and community leaders a glimpse at designs that are being implemented across the continent. These may or may not incorporate solutions to design issues that individual agencies currently face in their local areas. The following examples are repeated in the Appendix with additional information if more context is desired.

### *4.3.1 Austin, TX: Capital Metropolitan Transportation Authority (Capital Metro)*

- **Stop location –** Although stop location information can seem redundant with municipal signs that display street names, the information is an important resource in neighborhoods where municipal signs are rare or difficult to find. Furthermore, the information allows customer information agents a method of confirming locations of users along with unique stop ids.

Figure 4.1. Capital Metro Sign with Stop Location and Destination

- **Destination –** The display of the route destination provides a user, who is familiar with the area, with a context in which to begin constructing a cognitive map for a route. Moreover, the destination can also be a major POI that may attract non-users into the system by providing the group with information that they would not otherwise seek on their own.

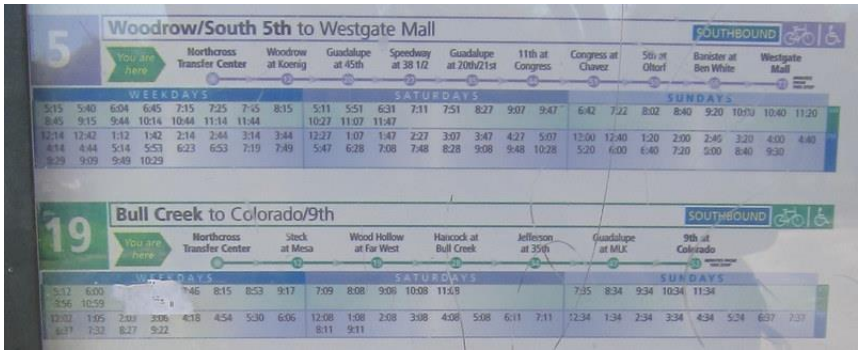



Figure 4.2. Capital Metro Stop-Specific Schedule

- **Stop-specific schedules paired with stop-specific diagrammatic route maps with accompanying time and transfer points –** Stop specificity removes a large obstacle for user comprehension of schedules and maps. Both users who are unfamiliar with an area and users with low schedule literacy may spend unnecessary amounts of time attempting to determine their location within the framework of the timetable or map. This can lead to user confusion and frustration. Stop-specific information allows users to skip this initial step in the process and only look for their destination. Similarly, diagrammatic maps reduce complexity for visualizing maps. The estimated travel times to time and transfer points on these maps allows the user to estimate their time of arrival, potentially reducing stress with a sense of certainty.

- **Scheduled next bus methods –** The panels offer users four methods (call, text, web, QR code) by which to find out when the next bus is scheduled to arrive. No other system offered, or at least advertised, as many ways to seek this same information. However, scheduled information is limited in its accuracy, depending on strong on-time performance (OTP). Nevertheless, the offering covers everyone with access to any type of mobile phone, 'basic', 'featured', or 'smart'. The use of remote information allows flexibility for modifications; for instance, should Capital Metro begin using a GPS-based automatic vehicle locator (AVL) for next bus information, the transition will require fewer resources for adoption in the field.

Figure 4.3. Capital Metro Bus Stop Panel

### *4.3.2 Boston, MA: Massachusetts Bay Transportation Authority (MBTA)*

- **Sign dimensions** – Unlike other transit systems, MBTA employs a tall and narrow basic bus stop sign. This format requires more text wrapping (or stacking), however; its shape is an immediate indicator to pedestrians of its identity. Moreover, since the sign is not double-sided, it only faces on-coming traffic. In this situation, pedestrians typically must guess if the

backside of a sign is the backside of a bus stop sign, a parking sign, or any number of other street-side signs. However, the silhouette suggests its function without the added cost of fabricating a double-sided sign or an identical backside for the bus stop sign.

Figure 4.4. MBTA Bus Stop Sign

- **Parking Restriction Integration**– Many agencies have parking restrictions at their stops and post separate signs to that effect at each of them, MBTA efficiently reduces the number of signs it must manufacture by integrating parking restrictions at the bottom of each sign. While the agency could further reduce fabrication costs by posting that such a restriction prohibits parking 'X' number of feet in front of the sign, this may present legal challenges over whether people should be expected to be able to estimate a set number of feet. To avoid this issue, MBTA places another sign at the front of the restriction zone to identify precisely where a driver may not park.

### *4.3.3 Charlotte, NC: Charlotte Area Transit System (CATS)*


Figure 4.5. CATS Signage System

- **Scaling Signs** – CATS fabricates bus stop signs that scale based on the number of routes that serve a bus stop. Signs begin with a short style that can list up to two routes, which can be expanded to a tall style with four routes and doubled with a symmetrical sign for up to eight routes—a potential limitation for other systems. Yet, this scaling ensures a large uniform typeset that makes route numbers legible from a distance. Color-coded route types provide additional distance-based recognition.

### *4.3.4 Denver, CO: Regional Transportation District – Denver (RTD)*


Figure 4.6. RTD Bifacial Bus Stop Sign

- **Bifacial Sign –** This bifacial sign is unlike most bus stop signs; transit agencies usually fabricate signs with one side with a metallic backside or two identical sides. The "My Ride" and "My Stop" signs employ similar maroon rounded rectangular decals as their base. This cohesion should allow passengers to identify the stops without issue regardless of which side of the sign they are facing. Meanwhile, the subtle difference allows RTD to display more information using less space with the assumption that a passenger can move to the other side of the sign if they are looking for information not found on the side facing them.
- **Stop Lettering –** RTD utilizes letters (eg X, Y, Z) to identify stops block-by-block along certain streets in downtown Denver. This system improves operational efficiency by limiting the number of buses that stop


Figure 4.7. RTD Bus Stop Identification by Letter Signage

block in a transit-congested area. It also offers a clear distinction between bus stops for passengers and indicates to them that each stop is served by different bus routes; and therefore, they should not to expect all buses to stop at each location. Passengers can confirm this characteristic by comparing the routes on "The Ride" signs of each bus stop.

**Bus Bay Maps –** RTD prints bus bay (known as "gates" in Denver) maps to accompany route maps at RTD-owned facilities with large

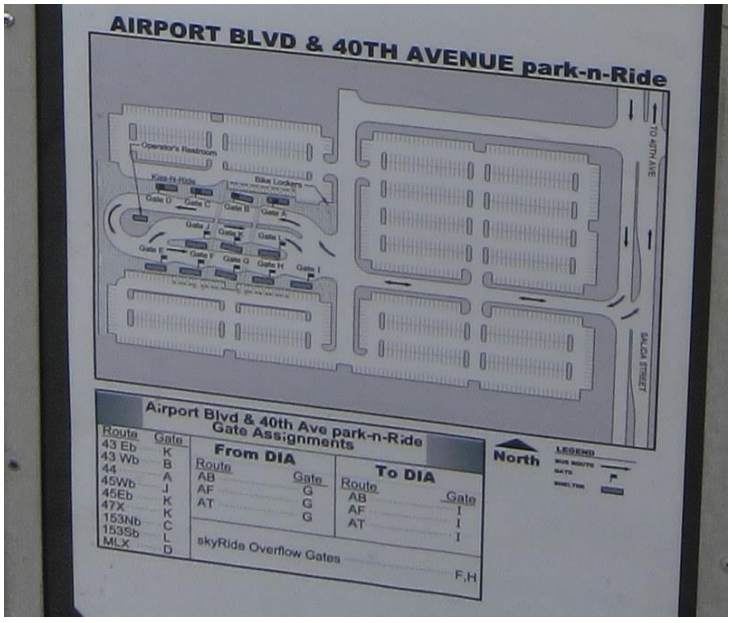



Figure 4.8. RTD Bus Bay Map below Route Map (route map not shown)

numbers of bays. These maps are similar to terminal maps at airports with gates; both work to reduce the complexity that exists due to the large number of choices. These maps not only show where particular bays are located, but also list the assignments to each bay so that a passenger can glance at this map and list to find out where they need to go to board their respective bus.

### *4.3.5 Ft Lauderdale, FL: Broward County Transit (BCT)*

- **Handicap Accessibility Decal –** BCT uses a decal to identify handicap-accessible *stops*. This is separate from handicap-accessible decals that represent handicap-accessible buses, which are far more common in major North American transit systems. This application comes with some inherent risk should stops with these decals become non-compliant. Nevertheless, this application feels more appropriate and significantly more useful to handicap passengers, particularly when all buses in a system are handicap-accessible, in which case the need for this knowledge is reduced to a first experience. The use of the decal to

Figure 4.9. BCT Bus Stop Sign with Handicap Accessibility Decal

identify bus stops for bus-related purposes only becomes relevant and useful when select stops have handicap-accessible buses.

### *4.3.6 Houston, TX: Metropolitan Transit Authority of Harris County (Metro)*

- **Individual Sign Sheets per Route –** Metro is one of only a few transit agencies to post bus stop signs whose size are customizable based on the precise number of bus routes that serve each stop. This allows Metro to print route information signs in large quantities and place them as appropriate. Furthermore, this allows the agency to add more information as resources become available without revamping the entire signage system, making it flexible to modifications decreasing potential capital costs of improvements. Drawbacks are potentially increased labor costs for fabrication compared with decals and typeset size constraints based on the height and width of each standard route information sign sheet.


Figure 4.10. Metro Bus Stop Sign

### *4.3.7 Los Angeles, CA: Los Angeles County Metropolitan Transportation Authority (LACMTA)*

- **Frequency Decal** – LACMTA does not use schedules at its bus stops; rather, the agency relies on shorter and less complex frequency tables. While these tables are route dependent and cannot allow a user to estimate the time when a bus will arrive if they have not yet seen a bus pass, they give a user a sense of how long they should expect to wait at most. Schedules are often unwieldy, even for regular users. Frequency tables simplify the schedule and, to an extent, avoid the problem of providing an estimated bus stop time at a non-time point. Moreover, because frequency tables are much more condensed, LACMTA prints them on decals to place directly on the signpost, lowering the installation and maintenance costs that would otherwise exist with infrastructure such as a signpost panel.

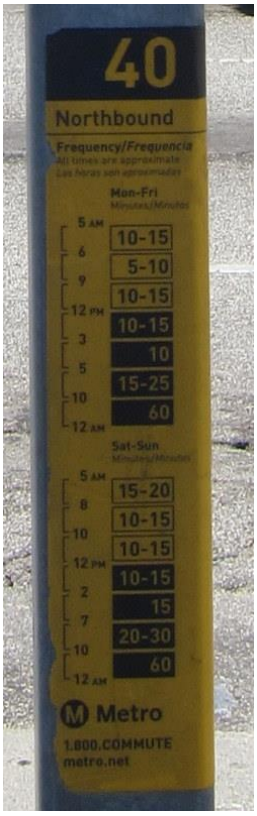


Figure 4.11. LACMTA Frequency Decal

### *4.3.8 Memphis, TN: Memphis Area Transit Authority (MATA)*


Figure 4.12. MATA Bus Stop Sign Base (left); MATA Bus Stop Sign with Decal (right)

- **Decal for Improved Information** - To improve its customer information system, MATA applies a decal over the words "Bus Stop" on its low information signs. This replaces a somewhat useful element, which serves to assure customers of the purpose of the sign, with a decal that provides a significantly higher level of information. A transit agency should identify its stops either by words or by universal icons and the bus icon that MATA uses at its stops is proficient for this purpose. As a result, MATA can free up some of the space on its signs for a higher and better use. This is a low-cost alternative to sign replacement and is a viable option for many transit agencies whose budgets do not allow for a sign redesign and fabrication process.

### *4.3.9 Miami, FL: Miami-Dade Transit (MDT)*

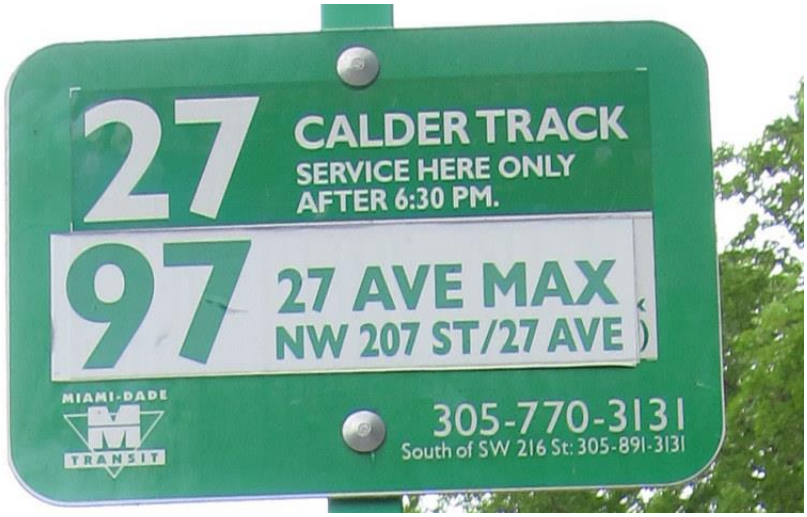



Figure 4.13. MDT Bus Route Information Decals

- **Elongated Route Information Decal –** Printing decals is a less expensive alternative to printing new signs for improving and/or updating customer information at bus stops. Decals are an aesthetic trade-off to printing though, as they deteriorate at a different rate than the sheet metal, peel, and look sloppy when carelessly applied. However, for systems with insufficient funds for a sign redesign, decals offer an opportunity to present large amounts of information on vacant or inefficient sign space.

### *4.3.10 Minneapolis, MN: Metro Transit*


Figure 4.14. Metro Transit High Frequency Flags (Photos from Metro Transit)

- **High Frequency Flag**

  Metro Transit indicates stops that serve high frequency routes with bright red signs next to its basic bus stop sign. These flags draw attention to highly reliable service on users should be able to depend with the hope of attracting ridership to these routes.

### *4.3.11 New York, NY: MTA New York City Transit (NYCT)*


Figure 4.15. NYCT Guide-A-Ride

- **Guide-A-Rides (four-sided panels)**

  NYCT makes extensive use of four-sided panels, which the agency refers to as "GARs" or Guide-A-Rides. GARs are found in a number of transit systems, but only OC Transpo in Ottawa, ON uses them as widely as NYCT. GARs at bus stops with only one bus provide space for very high levels of information not commonly found in even the best information systems in this survey. The consistently high level of information provides assurance to users that they will have the resources to reach their destination with the given information without relying on external sources. This affords users with a greater sense of independence. While

GARs can be expensive to install and maintain, NYCT leverages their benefits to the highest and best use possible.

### *4.3.12 Philadelphia, PA: Southeastern Pennsylvania Transportation Authority (SEPTA)*


- **Use of Shelter Frame**

  SEPTA posts route numbers, stop location, and frequency information directly on to shelter frames. This frees up the little space that remains in some shelters—mostly found in the city center—to display more robust route information with the inclusion of detailed "You Are Here" route maps, which are developed in coordination with the city's large pedestrian sign system, Walk!Philadelphia.


Figure 4.16. SEPTA Shelter Frame Bus Stop Information

### *4.3.13 San Antonio, TX: VIA Metropolitan Transit (VIA)*

- **Trailblazers for Connecting Routes**

  VIA uses trailblazers that indicate to bus operators which direction they should turn at certain intersections. Trail blazers of this ilk also indicate to users where they should make a transfer as these points exist at locations where routes diverge from each other. Although not all buses may stop at these locations, they are the represent the last opportunity to make a convenient transfer to a nearby stop.


Figure 4.17. VIA Bus Stop Sign with Trailblazers

### *4.3.14 San Francisco, CA: San Francisco Municipal Transportation Agency (MUNI)*

- **System Map with Frequency Tables**

  The MUNI map is similar to many other system maps found in display panels; however, its addition of frequency tables and an inset map for late-night service make this map stand out. The frequency tables take into account different times of day and different days of the week and compile all of the routes together in a compact and easy-to-read manner. While this is not necessarily the best way to present schedule information

for routes that have low frequencies, it is a strong planning tool for determining route selection based purely on headways and the probability of low transfer times. Since much of the MUNI bus routes have high frequencies, these tables are a workable substitute for individual route schedules, reducing space needs.

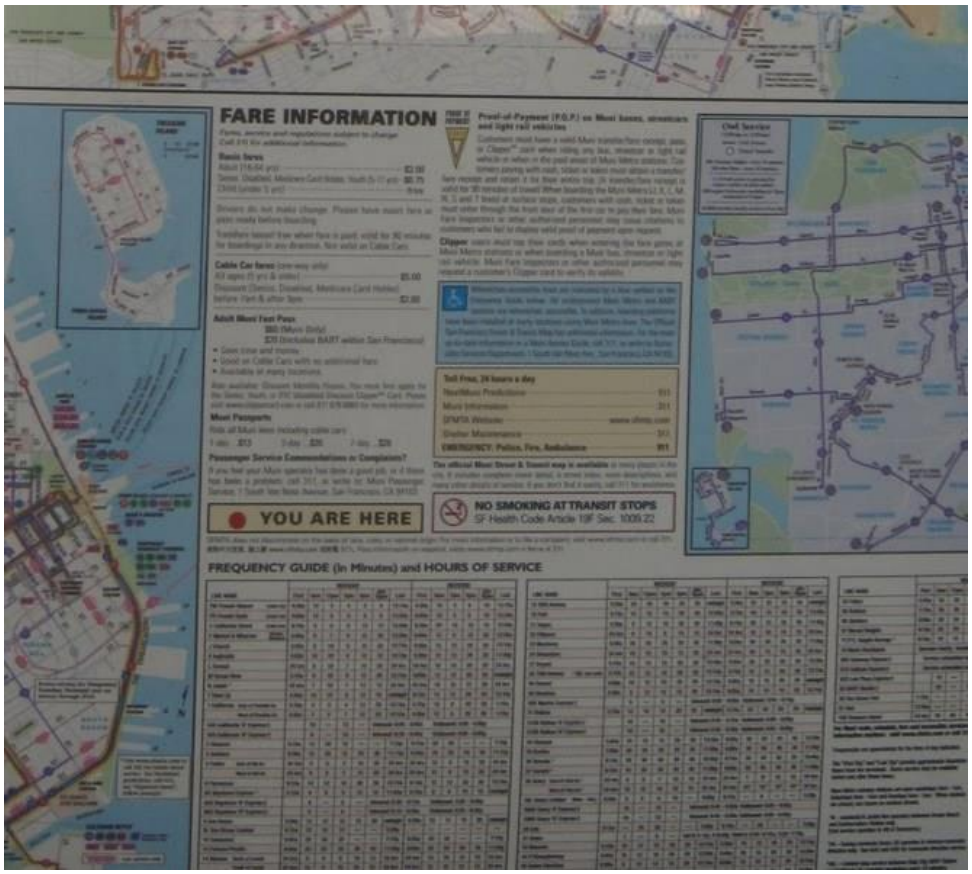



Figure 4.18. MUNI Map with Frequency Tables

### *4.3.15 Seattle, WA: King County Metro Transit (King County Metro)*

- **Modal Symbol for Bus Connections**

Though a little utilized part of an element at King County Metro, the inclusion of a modal symbol next to route numbers on select signs in downtown Seattle allows users to filter out routes quickly when trying to determine which will take them to their destination. This is most useful when there are a large number of routes, which can burden a user and slow down decision-making.

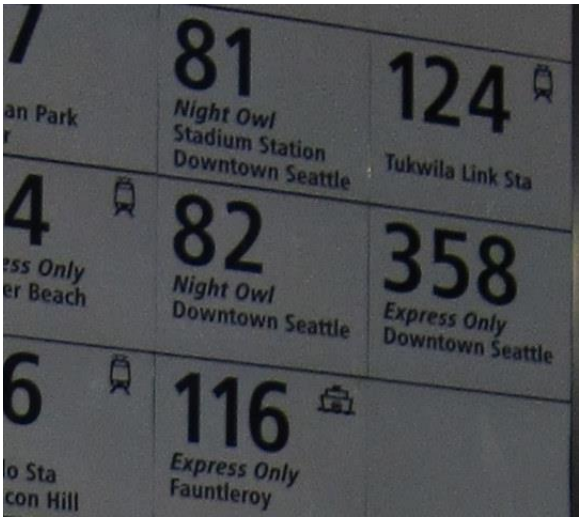



Figure 4.19. King County Metro Bus Stop Pylon with Bus Route Numbers and Modal Connections

### *4.3.16 Toronto, ON: Toronto Transit Commission (TTC)*


Figure 4.20. TTC Signage with Different Hours of Service, 24 Hours (left); Day (center); Night (right)

- **Sign Design Color**

  TTC bus stop signs have a red, blue, or red/blue striped bottom and top. These colors reflect the hours in which the buses that serve the stop are in operation. A red stripe indicates day only service, a blue stripe indicates night-only service, and red/blue stripes indicate 24 hour service. This is a clever way to demonstrate service without a schedule or when looking at a stop from a distance.

- **Bike Accessibility Symbol**

  TTC uses a simple symbol to show that buses have FMRs to hold bicycles for users. Unfortunately, the symbol is small and found on the upper left corner of the route schedules rather than on the bus stop signs

themselves, but it is a unique way to display this information. It is useful for agency's that already depict a bus and want to provide bike accessibility information without using more space.

Figure 4.21. TTC Bus Icon

### *4.3.17 Washington, D.C.: Washington Metropolitan Area Transit Authority (WMATA)*


Figure 4.22. WMATA Bus Information Panel

- **Bus Information Panel at Stations –** WMATA offers customers one of the most feature-rich bus information panels at stations. It utilizes a "You Are Here" map that pulls in all routes that connect to the station and, with the relatively large scale as compared with a system map, WMATA

applies the necessary elements for an neighborhood map complete with POIs. Adjacent to this map is a smaller bus bay map, when applicable, or a local area map oriented around the station. Furthermore, a table lists the bus routes with the days and frequencies with which they run. Finally, the panel has fare, contact, and accessibility information. While information panels at stations are common, few have so many features nested in as compact a manner as that in WMATA. This frees up space on other panels for other information or advertisements.

# CHAPTER 5: APPLICATION OF RESULTS

This chapter presents conclusions derived from the results with discussions that focus on bus stop signage. This chapter identifies recommendations for signage concept development; it outlines design principles that should be considered when laying out information on such signage; and, it provides design samples based on the recommendations so as to offer ideas on how they might be implemented at different scales. Lastly, this chapter discusses barriers to improving user information and opportunities to add to the resources in the future.

## 5.1 Design Concept Development

The primary recommendation of this thesis is to maximize the information that is available on the basic bus stop sign, which sets a solid foundation on which to add further layers of user information at other tiers using space that is freed up and made available by sign changes. This section provides guidance on the development of the basic bus stop sign design concept. When this concept is complete, a layout for the information can be developed after which the concept can be carried forward for engineering with materials selection and fabrication.

Before a transit agency takes on the design process, it should assess the cost potential for all of the different information elements. The cost of any sign program will be divided into two parts: fabrication/installation and upkeep. Initially, nearly all costs for a sign program are associated with fabrication and installation; however, once a program has been fully implemented, a greater proportion of expenses shift to upkeep.

Fabrication and installation continues during service changes when new stops are added as well as a part of the regular maintenance program when signs are damaged, vandalized, missing, or reach the end of their useful life. Meanwhile, upkeep is necessary when minor modifications take place. These modifications may require the application or removal of decals, schedules, or other interchangeable elements. Tables 5.1 and 5.2 show sample tables using relative costs to transit agencies. The scales in Table 5.2 can be reconfigured to assess cost ranges to reflect estimated costs to an agency.

Table 5.1. Information Element Cost Assessment Worksheet for Installation

| | | Customization Specificity | | | |
|---|---|---|---|---|---|
| | Value | 0 | 1 | 2 | 3 |
| | Scale | Dynamic | System | Route | Stop |
| Identification | | | | | |
| | Stop ID | | | | 3 |
| Location Information | | | | | |
| | Stop Location | | | | 3 |
| | Bay Locations | | | 2 | |
| | You Are Here Map | | | | 3 |
| Route Information | | | | | |
| | Route Numbers/Name | | | 2 | |
| | Direction | | | 2 | |
| | Route Map | | | 2 | |
| | Destination(s) | | | 2 | |
| | Connecting Routes | | | 2 | |
| Scheduling Information | | | | | |
| | Days/Hours of Operation | | 1 | 2 | |
| | Route Schedule | | | 2 | |
| | Frequency | | | 2 | |
| | Scheduled Next Bus - Electronic Board | 0 | | | |
| | Scheduled Next Bus - Text | | 1 | | |
| | Scheduled Next Bus - Web | | 1 | | |
| | Scheduled Next Bus - QR | | 1 | | |
| | Scheduled Next Bus - Call | | 1 | | |
| | Real-Time Next Bus - Electronic Board | 0 | | | |
| | Real-Time Next Bus - Text | | 1 | | |
| | Real-Time Next Bus - Web | | 1 | | |
| | Real-Time Next Bus - QR | | 1 | | |
| | Real-Time Next Bus - Call | | 1 | | |
| System Information | | | | | |
| | System Map | | 1 | | |
| | POI Guide | | 1 | | |
| General Information | | | | | |
| | Fare Information | | 1 | | |
| | Safety Information | | 1 | | |
| | Public Message Board | | 1 | | |
| | Revision Date | | | 2 | 3 |
| | Website | | 1 | | |
| Contact Information | | | | | |
| | Phone Number | | 1 | | |
| | TTY/TDD | | 1 | | |
| Accessibility Information | | | | | |
| | Wheelchair Accessibility | | 1 | 2 | 3 |
| | Bicycle Accessibility | | 1 | 2 | |

Table 5.2. Information Element Cost Assessment Worksheet for Upkeep

| Stop-Specific Upkeep | | Probability of Change | | | | | | Magnitude of Change | | | | | Incremental Cost of Change | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Value | 0 | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 | |
| | Scale | Constant | Very Low | Low | Medium | High | Very High | Stop | Stops | Route | Routes | System | Very Low | Low | Medium | High | Very High | Risk |
| Identification | | | | | | | | | | | | | | | | | | |
| | Stop ID | 0 | | | | | | | | | | | | | | | | 0 |
| Location Information | | | | | | | | | | | | | | | | | | |
| | Stop Location | 0 | | | | | | | | | | | | | | | | 0 |
| | Bay Locations | | | 2 | | | | 1 | | | | | | 2 | | | | 5 |
| | You Are Here Map | | 1 | | | | | | 2 | | | | | | | 4 | | 7 |
| Route Information | | | | | | | | | | | | | | | | | | |
| | Route Numbers/Name | | 1 | | | | | | | 3 | | | 1 | | | | | 5 |
| | Direction | | 1 | | | | | | | 3 | | | 1 | | | | | 5 |
| | Route Map | | | | 3 | | | | | 3 | | | | 2 | | | | 8 |
| | Destination(s) | | 1 | | | | | | | 3 | | | 1 | | | | | 5 |
| | Connecting Routes | | | 2 | | | | | | | 4 | | | 2 | | | | 8 |
| Scheduling Information | | | | | | | | | | | | | | | | | | |
| | Days/Hours of Operation | | 1 | | | | | | | | | 5 | 1 | | | | | 7 |
| | Route Schedule | | | | 3 | | | | | 3 | | | 1 | | | | | 7 |
| | Frequency | | | 2 | | | | | | 3 | | | 1 | | | | | 6 |
| | Scheduled Next Bus - Electronic Board | 0 | | | | | | | | | | | | | | | | 0 |
| | Scheduled Next Bus - Text | 0 | | | | | | | | | | | | | | | | 0 |
| | Scheduled Next Bus - Web | 0 | | | | | | | | | | | | | | | | 0 |
| | Scheduled Next Bus - QR | 0 | | | | | | | | | | | | | | | | 0 |
| | Scheduled Next Bus - Call | 0 | | | | | | | | | | | | | | | | 0 |
| | Real-Time Next Bus - Electronic Board | 0 | | | | | | | | | | | | | | | | 0 |
| | Real-Time Next Bus - Text | 0 | | | | | | | | | | | | | | | | 0 |
| | Real-Time Next Bus - Web | 0 | | | | | | | | | | | | | | | | 0 |
| | Real-Time Next Bus - QR | 0 | | | | | | | | | | | | | | | | 0 |
| | Real-Time Next Bus - Call | 0 | | | | | | | | | | | | | | | | 0 |
| System Information | | | | | | | | | | | | | | | | | | |
| | System Map | | | | | | 5 | | 2 | | | | | | 3 | | | 10 |
| | POI Guide | | | | | 4 | | | 2 | | | | | | 3 | | | 9 |
| General Information | | | | | | | | | | | | | | | | | | |
| | Fare Information | | 1 | | | | | | | | | 5 | | 2 | | | | 8 |
| | Safety Information | 0 | | | | | | | | | | | | | | | | 0 |
| | Public Message Board | 0 | | | | | | | | | | | | | | | | 0 |
| | Revision Date | | | | 3 | | | | | 3 | | | | 2 | | | | 8 |
| | Website | 0 | | | | | | | | | | | | | | | | 0 |
| Contact Information | | | | | | | | | | | | | | | | | | |
| | Phone Number | 0 | | | | | | | | | | | | | | | | 0 |
| | TTY/TDD | 0 | | | | | | | | | | | | | | | | 0 |
| Accessibility Information | | | | | | | | | | | | | | | | | | |
| | Wheelchair Accessibility* | 0 | 1 | | | | | 1 | | | | | | | 3 | | | 5 |
| | Bicycle Accessibility* | 0 | 1 | | | | | | | 3 | | | 1 | | | | | 5 |
| | | | | | | | | | | | | | | | | | Total | 108 |

*Wheelchair accessibility determination varies by transit agency. Assessment may be done from a site accessibility perspective or a bus accessibility perspective; if the latter and all buses are outfitted with lifts or plates, then it is constant

**Bicycle accessibility determination varies by transit agency. Assessment is based on the ubiquity of FMRs; if all buses are outfitted, then it is constant

| Relative Risk | |
|---|---|
| Information Elements | |
| 0 - 3 | Very Low Risk |
| 4 - 6 | Low Risk |
| 7 - 9 | Moderate Risk |
| 10 - 12 | High Risk |
| 13 - 15 | Very High Risk |
| | |
| Overall | |
| 0 - 56 | Very Low Risk |
| 57 - 104 | Low Risk |
| 105 - 152 | Moderate Risk |
| 153 - 200 | High Risk |
| 201 - 240 | Very High Risk |

Table 5.1 considers the specificity of elements, which provides insight into fabrication and installation costs. When an element is system-specific, it is fixed throughout the system and thus is a candidate for printing directly onto signs for mass production system-wide. Maximizing the number of elements that can be efficiently printed onto a

sign ‘blank’ reduces the time and labor required for decal printing and application. Each other element, including those which do not pass for the sign ‘blank’, is a candidate for a decal or inclusion in a panel installation—separate from the sign.

Table 5.2, which considers the upkeep cost potential of elements, helps to parse the elements further. Through an aggregation of three categories, probability of change, magnitude of change, and incremental cost of change, it assesses the relative risk of providing elements at each bus stop. The probability of change examines the likelihood that an element would be affected in some way by semiannual or other service changes in a year. The magnitude of change examines the number of stops associated with a modification to an element. The incremental cost of change examines the design, printing, and distribution costs associated with a modification to an element. The elements in Table 5.2 that are designated as “constant” for probability of change are not likely to change due to service changes. As a result, they are semi-permanent elements that have very low relative risk, which require little upkeep from an infrastructure standpoint. Most of these very low relative risk elements link to remote resources, which require maintenance on the backend.

While fabrication/installation and upkeep costs are not the only costs related to the information elements, they represent the physical costs. Non-physical costs include internal and customer service activities such as database management, web and application development, and call center staffing for remote resources. However, Tables 5.1 and 5.2 assume that these activities would still be funded even if the signs did

not provide information about them. Consequently, these tables consider those costs to be sunk.

After assessing the cost potential of the different information elements, transit agencies can make decisions tailored to meet their individual needs and funding capacities. Information elements that are not selected for inclusion into a basic bus stop sign design concept are candidates for inclusion at higher level tiers in the bus system. For instance, while a route map with the connecting routes can arguably be disseminated heavily throughout a system at high information bus stops, it has a high upkeep cost potential compared with other route information elements. As such, it may be best for an agency with limited funds to restrict the elements to shelter bus stops and stations to minimize the overall cost potential of the sign program. In Table 5.2, this would effectively shift the magnitude for change for these two elements from “Route” and “Routes”, respectively, to “Stops”. These shifts would move the overall sign program from the moderate risk range into the low risk range.

The development of the design concept must consider the tiers at which the information elements may be disseminated. Table 5.2 values in the magnitude of change category relate directly to the tiers. Table 5.3 shows how a transit agency can populate this category, which unlike the other two categories, is not based on relative values. Also, Table 5.3 is a visioning tool for conceptualizing the reach of information elements across the system. It also provides an outline of the elements that are to be

included at each tier, working as a reminder of all included elements throughout the remainder of the design process.

Table 5.3. Tier Visioning Tool with Magnitude of Change per Information Element

| | Tier | Low Info | High Info | Shelter | Station |
|---|---|---|---|---|---|
| | Magnitude of Change | System | Routes/ Route | Stops | Stops/ Stop |
| Identification | | | | | |
| | Stop ID | ✓ | ✓ | ✓ | ✓ |
| Location Information | | | | | |
| | Stop Location | ✓ | ✓ | ✓ | ✓ |
| | Bay Locations | | | | ✓ |
| | You Are Here Map | | | | ✓ |
| Route Information* | | | | | |
| | Route Numbers/Name | ✓ | ✓ | ✓ | ✓ |
| | Direction | ✓ | ✓ | ✓ | ✓ |
| | Route Map | | ✓ | ✓ | ✓ |
| | Destination(s) | ✓ | ✓ | ✓ | ✓ |
| | Connecting Routes | | ✓ | ✓ | ✓ |
| Scheduling Information | | | | | |
| | Days/Hours of Operation | | ✓ | ✓ | ✓ |
| | Route Schedule | | ✓ | ✓ | ✓ |
| | Frequency | | ✓ | ✓ | ✓ |
| | Scheduled Next Bus - Electronic Board | | | | - |
| | Scheduled Next Bus - Text | - | - | - | - |
| | Scheduled Next Bus - Web | - | - | - | - |
| | Scheduled Next Bus - QR | - | - | - | - |
| | Scheduled Next Bus - Call | - | - | - | - |
| | Real-Time Next Bus - Electronic Board | | | | ✓ |
| | Real-Time Next Bus - Text | ✓ | ✓ | ✓ | ✓ |
| | Real-Time Next Bus - Web | ✓ | ✓ | ✓ | ✓ |
| | Real-Time Next Bus - QR | ✓ | ✓ | ✓ | ✓ |
| | Real-Time Next Bus - Call | ✓ | ✓ | ✓ | ✓ |
| System Information | | | | | |
| | System Map | | | ✓ | ✓ |
| | POI Guide | | | | ✓ |
| General Information | | | | | |
| | Fare Information | ✓ | ✓ | ✓ | ✓ |
| | Safety Information | ✓ | ✓ | ✓ | ✓ |
| | Public Message Board | | | | ✓ |
| | Revision Date | | ✓ | ✓ | ✓ |
| | Website | ✓ | ✓ | ✓ | ✓ |
| Contact Information | | | | | |
| | Phone Number | ✓ | ✓ | ✓ | ✓ |
| | TTY/TDD | ✓ | ✓ | ✓ | ✓ |
| Accessibility Information | | | | | |
| | Wheelchair Accessibility | ✓ | ✓ | ✓ | ✓ |
| | Bicycle Accessibility | ✓ | ✓ | ✓ | ✓ |

* Route information changes are isolated to a route or sections of a route(s), they do not require system-wide changes

## 5.2 Design Principles and Requirements

The graphic system in signage design has a number of different components. These components include typography, symbols and arrows, diagrams, color, and layout (Calori, 2007). The vast majority of bus stop signs integrate three and often four of these components into the sign, excepting diagrams and occasionally symbols and arrows. Diagrams, or maps, are usually found in stop panels and larger display cases rather than on the sign itself. While this topic is fairly extensive, this section focuses on requirements that constrain the design put forward as a result of the Americans with Disabilities Act (ADA). More information on the components can be found in TCRP Report 12.

The ADA mandates that new and modified facilities, including outdoor facilities such as bus shelters and signage, meet design standards set by the Access Board and maintained by the US Department of Transportation. The following section exhibits selections that relate to bus stop signage from the standards, known as the ADA Standards for Transportation Facilities (USDOT, 2010). These standards replicate the ADA and ABA Accessibility Guidelines, on which the standards were based. However, while the ADA Standards have legal authority, the guidelines do not. Some discrepancies exist between the standards and guidelines, none of which affect bus stop signage though. Other standards that relate to other user information elements as well as bus stops and transportation facilities more generally are not provided here (Access Board, 2004).

810.4 Bus Signs. Bus route identification signs shall comply with 703.5.1 through 703.5.4, and 703.5.7 and 703.5.8. In addition, to the maximum extent practicable, bus route identification signs shall comply with 703.5.5.

EXCEPTION: Bus schedules, timetables and maps that are posted at the bus stop or bus bay shall not be required to comply.

703.5.1 Finish and Contrast. Characters and their background shall have a non-glare finish. Characters shall contrast with their background with either light characters on a dark background or dark characters on a light background.

Advisory 703.5.1 Finish and Contrast. Signs are more legible for persons with low vision when characters contrast as much as possible with their background. Additional factors affecting the ease with which the text can be distinguished from its background include shadows cast by lighting sources, surface glare, and the uniformity of the text and its background colors and textures.

703.5.2 Case. Characters shall be uppercase or lowercase or a combination of both.

703.5.3 Style. Characters shall be conventional in form. Characters shall not be italic, oblique, script, highly decorative, or of other unusual forms.

703.5.4 Character Proportions. Characters shall be selected from fonts where the width of the uppercase letter "O" is 55 percent minimum and 110 percent maximum of the height of the uppercase letter "I".

703.5.5 Character Height. Minimum character height shall comply with Table 703.5.5. Viewing distance shall be measured as the horizontal distance between the character and an obstruction preventing further approach towards the sign. Character height shall be based on the uppercase letter "I".

703.5.5 Visual Character Height

| **Height to Finish Floor or Ground from Baseline of Character** | **Horizontal Viewing Distance** | **Minimum Character Height** |
|---|---|---|
| 40 inches (1015 mm) to less than or equal to 70 inches (1780 mm) | less than 72 inches (1830 mm) | 5/8 inch (16 mm) |
| | 72 inches (1830 mm) and greater | 5/8 inch (16 mm), plus 1/8 inch (3.2 mm) per foot (305 mm) of viewing distance above 72 inches |

| | | |
|---|---|---|
| | | (1830 mm) |
| Greater than 70 inches (1780 mm) to less than or equal to 120 inches (3050 mm) | less than 180 inches (4570 mm) | 2 inches (51 mm) |
| | 180 inches (4570 mm) and greater | 2 inches (51 mm), plus 1/8 inch (3.2 mm) per foot (305 mm) of viewing distance above 180 inches (4570 mm) |
| greater than 120 inches (3050 mm) | less than 21 feet (6400 mm) | 3 inches (75 mm) |
| | 21 feet (6400 mm) and greater | 3 inches (75 mm), plus 1/8 inch (3.2 mm) per foot (305 mm) of viewing distance above 21 feet (6400 mm) |

These standards present a target for the basic components of signage design to ensure legibility, which is arguably the most important feature of a bus stop sign. When elements cannot be read, the information that they provide are of little use.

## 5.3 Design Concept Samples

The following design concept recommendation, Figure 5.1 and Figure 5.2, with the included elements is attainable for most large transit agencies. It is considered as an ideal that maximizes the distribution of information at a minimal incremental cost. This does not mean that the other elements cannot or should not be added to a bus stop sign, but that adding them is a lower priority given space constraints or extraordinarily circumstantial. For example, Chicago Transit Authority (CTA) posts route maps on signs at stops that are served by only one route. While such supplementary information is

venerable, a very high level of network stability is necessary to keep sign fabrication costs from jumping at each service change. Moreover, specialized information depends on the ability of a transit agency to collect and share the information. For example, if an agency has access to next bus information and a means to distribute such information, it is expected that such information be posted in the system and vice versa. The design concept is a starting point from which agencies can begin to customize a unique sign to fit their needs and capabilities.


Figure 5.1. Base Design Concept for MARTA using Current Sign Dimensions, front

This element is first due to its relationship to the above route and location information. The second element is the customer service number at which users can make any number of inquiries, comments, complaints, or concerns. The third element is the TTY/TDD number for the hearing impaired. The customer service number and the TTY/TDD number are listed together because they provide approximately the same service. The fourth and final element is the website at which more information can be found. This element is listed last both because it is a different service from the other three and because the service works best on a computer or smartphone, which is not immediately accessible to everyone on site. While all of these elements are visible, the layout determines the priority at which elements are given based on the Western reading style that begins on the top-left and ends at the bottom-right.

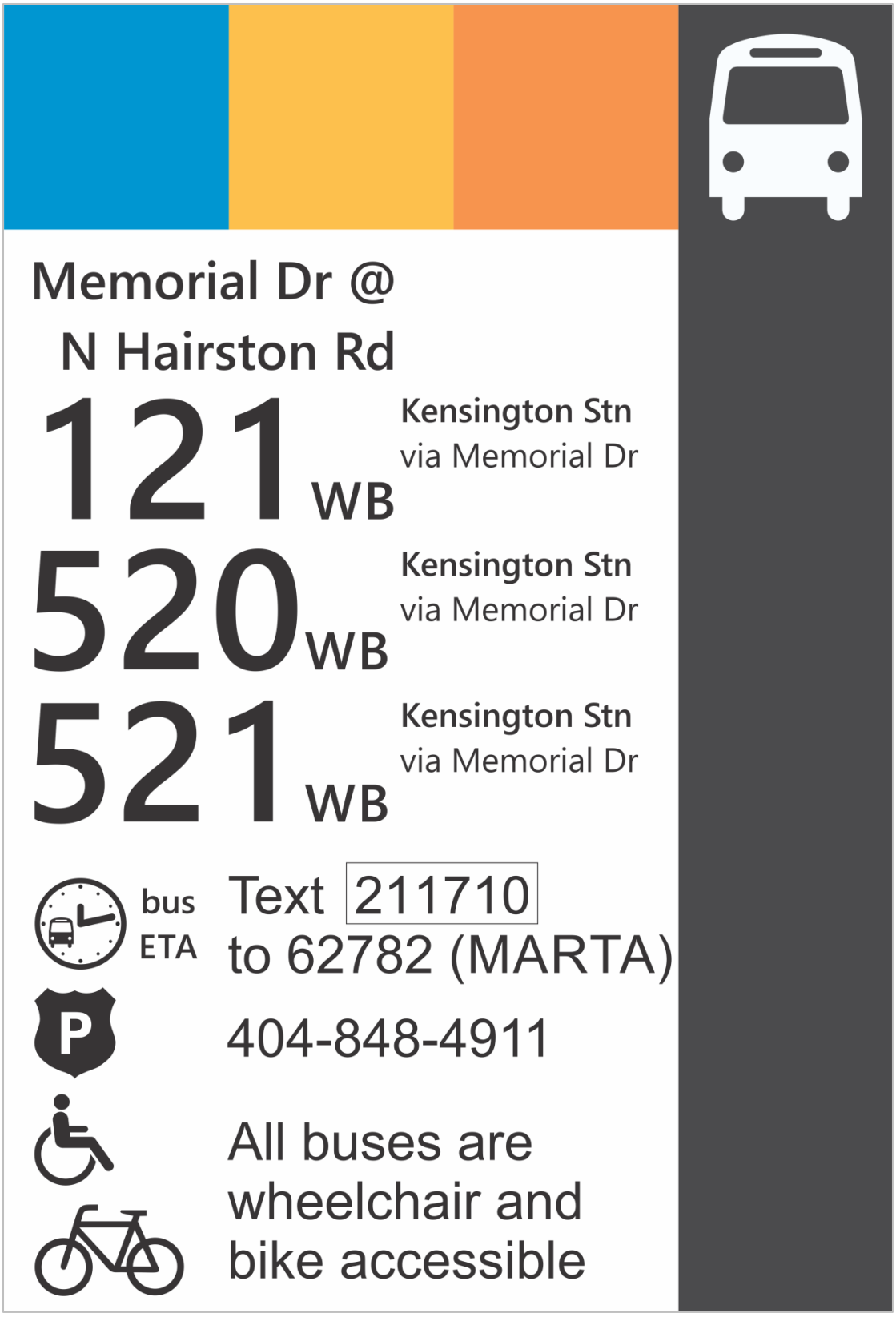



Figure 5.2. Base Design Concept for MARTA using Current Sign Dimensions, back

Figure 5.2, which is the backside of the Figure 5.1, utilizes the same information elements as Figure 5.1 but replaces the last three elements with safety, wheelchair accessibility, and bicycle accessibility information. The concept attempts to optimize the available space by keeping the key elements on both sides and expanding the number of information elements that the sign can display by replacing less essential elements with other less essential elements on the back-side. This design allows all information elements designated to the low information sign tier from the Tier Visioning Tool, Table 5.3, to be displayed except fare information. For MARTA, fare information has proved to be somewhat unstable over the past several years, which increases the risk of printing the element on the sign; hence, it is not present on the sign.

## 5.4 Post-Design Steps

After developing the design concept and printing proofs to work out potential flaws, the technical specifications must be drawn and documented to ensure that there are no miscommunications between the agency and the fabricator, whether the fabricator be a third-party or an in-house sign shop. Technical specs cover quality assurance, required submittals, quality standards, materials, fabrication and graphic application techniques, as well as installation processes (Calori, 2007). Once these specs are completed, the sign program can then proceed to bidding or directly to fabrication if an internal sign shop is implementing the project. Once signs are manufactured and installed, they need only be inventoried for asset management and maintained. However, it is good practice to evaluate the benefits of the signage and check for any improvements, such as ridership trends and user complaints/comments tracking, which might provide support

for further upgrades in the future at the transit agency. For more information regarding these next steps, please review TCRP Report 12.

## 5.5 Barriers and Opportunities

The principal obstacle to the improvement of signage is funding. Signage upgrades are designated as a low priority in many transit agencies since signs are not seen as serving a vital function. As a result, many sign programs remain in a period of stasis for long periods of time until an internal advocate or an external sponsor takes up the cause to move the program forward. For instance, many sign programs were upgraded recently with federal assistance through the American Recovery and Reinvestment Act (ARRA). Without external grants though, many agencies are unwilling to shift significant resources to sign programs when doing so would affect departments with a higher funding priority within the agency.

Rather than waiting for funding to avail itself for sign programs, it is suggested that agencies consider rolling out incremental upgrades. In this format, stops are prioritized to receive low-cost upgrades. These upgrades may be placed on decals which then can be applied directly onto existing signs to limit fabrication costs. In parallel, a new sign blank can be designed to provide a greater amount of information so that when work orders to replace signs come, the new design can be fabricated and seamlessly released for public consumption rather than the legacy sign. Depending on the design, this could be practically cost-neutral if specifications of the physical sign (ie the materials) remain the same. If the legacy signs are durable, the update cycle could take several years to

replace all bus stop signs. The fundamental view of this approach is that an agency should not continue to extend the lifecycle of very low information signs through replacement if it has the ability to modify the replacement signs with additional information without incurring markedly higher costs.

The incrementalist approach is not perfect. One of the negative aspects is that it leads to inconsistency across the system. New designs effectively add another tier; however, as the baseline tier provides fewer information resources, it is unlikely that a modified design that provides more information resources would receive pushback unless it is drastically different from the original. Furthermore, relying just on replacement to roll out new resources is not only slow, but also may lead to many low ridership stops receiving upgrades far in advance of high ridership stops. This issue can be curbed by replacing prioritized stops first and holding onto the removed signs to replace signs at low priority stops until the supply of the legacy signs is exhausted. However, this method would virtually triple the work involved in sign replacement as two signs would need to be removed for every work order that involves a low priority bus stop (high priority legacy bus stop sign taken down, low priority legacy bus stop sign taken down, high priority legacy bus stop sign replaces low priority legacy bus stop sign, modified bus stop sign added to high priority bus stop, low priority legacy bus stop sign is recycled). The provision of applying low-cost upgrades to prioritized stops in parallel avoids this logistical issue. Despite some limitations, incrementalism allows for progress when progress may not be otherwise possible.

As an example, the Metropolitan Atlanta Rapid Transit Authority (MARTA) is in the process of taking the prescribed approach as it seeks to upgrade its sign design system-wide. The agency has tentatively decided on a pilot to apply decals over portions of its legacy bus stop signs and add secondary signs, such as those in Figure 5.3 and Figure 5.4, at prioritized transfer points with high ridership. These decals are a significant step forward for the agency and the cost of the upgrade is negligible. After receiving feedback, the project is meant to expand the use of temporary decals to more stops throughout the system. In parallel, it is crafting new design concepts internally and regionally with a long-range plan to redesign the sign blank so that it incorporates many elements directly on the sign with dedicated space for decals to provide site-specific and route-specific information. While MARTA will perform an on-going assessment of its procedure and continue to seek grants to help the project to progress more quickly, the project design does not require outside funding for implementation to take place over time.


Figure 5.3. MARTA Design Concept Draft – Decal to Place on Legacy Sign

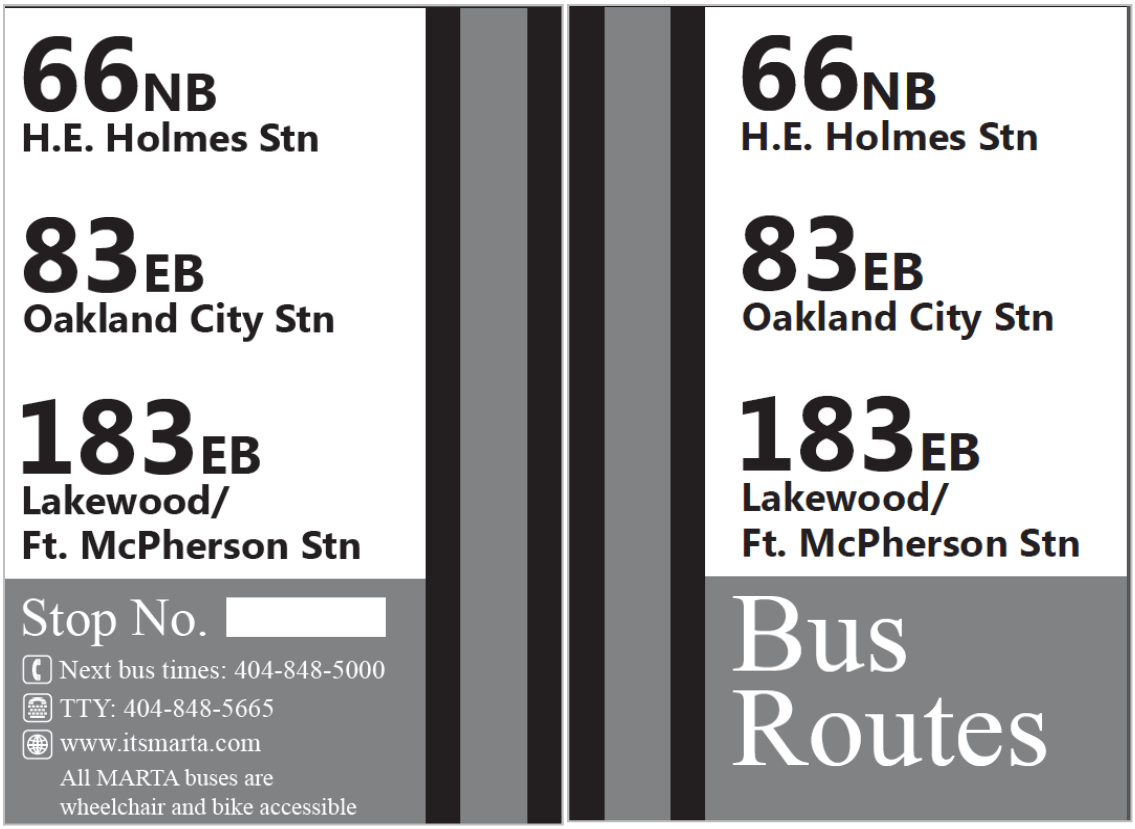



Figure 5.4. MARTA Design Concept Drafts – Secondary Information Sign to Place Opposite of Legacy Sign, back (left), front (right)

Although funding is and will likely remain a major barrier to the improvement of user information resources, a little design and implementation flexibility opens an agency up to low-cost and cost-neutral opportunities.

# CONCLUSION

This thesis has examined existing literature on wayfinding, the role of information, its delivery, and its different elements in transit systems. It has discussed the research approach using site visits to develop matrices that reveal the state of the practice. This thesis also has exhibited examples of innovative applications of elements found on the site visits. Finally, it has parsed these observations to construct recommendations for conceptualizing the information system and developing basic bus stop signage.

This thesis effectively updates past research on the current state of the practice with respect to user information at bus stops. In doing so, it also provides transit agencies with numerous examples of the application of different elements through photographs. Furthermore, this thesis offers guidance on the development of a design concept, which, when paired with research on materials and the fabrication process, gives transit agencies the tools necessary to think through and create a functional and well-designed signage system.

While this thesis included site visits to twenty-nine transit agencies, the inventory can be continually updated and added to with other sites. Similarly, by limiting the sites to large agencies, unique and innovative applications of elements by agencies that exist in smaller jurisdictions may have been overlooked. Also, in conducting the site visits, some elements that do exist in a transit agency may not have been observed and, thus, not recorded, potentially skewing the results. This last issue can be mitigated through review and confirmation of collected data from the respective transit agencies.

This thesis provides numerous opportunities for further research. In addition to updating these observations over time, the scope can be shifted to include secondary language information. During this study, it was noted that several agencies have bilingual, and sometimes even trilingual, signs. Braille was found at some locations too, but these observations were not recorded. Moreover, research that tracks the costs of the different applications of elements across a number of agencies or that monetizes the benefits that users recognize would be useful for helping other transit agencies target their resources based on available funding. Also, surveys and observational studies that consider the user's interaction with bus stop information could provide useful information about the perceptions of the user as to what they consider to be important as well as what they use most. This can help transit agencies decide which elements should be the most prominent and potentially drive them to provide such elements at all tiers.

Bus stops are an integral part of the transit system. They not only notify users of existing services, but they also can assist users in planning and making trips, promote specific services, and build support for related projects. By taking advantage of this role that bus stops and their accompanying user information play, transit agencies provide for a better customer experience and potentially enhance their public image.

# APPENDIX

## Atlanta, GA: Metropolitan Atlanta Rapid Transit Authority (MARTA)

**Information System Hierarchy:** Three-Tier

**Tier 1:** Sign - MARTA uses a basic bus stop sign. The sign includes the agency's stripe 'logo', the agency name "MARTA", and a customer service number.

**Tier 2:** Shelter – MARTA makes extensive use of its shelters with two large display panels. One panel holds the system map, while the other holds route information, schedule information, and, if space is available, fare, safety, website, contact, and accessibility information. Shelters do not have bus stop signs to designate the stop.

**Tier 3:** Station – MARTA multi-modal stations offer information similar to that posted in shelters. Stations also incorporate bus 'bay' locations at the main station, station and thus stop locations, and revision dates on the schedule information.

**System Evaluation:** MARTA utilizes a three-tiered information system: sign, shelter, station. This means that the agency does not provide additional passenger resources at signs, regardless of neighborhood or ridership level. Unfortunately, the current sign, which is a low information sign, lacks meaningful information that can help build expectancies for potential users. In order to make decisions on travel from these sign stops, the only option offered without outside information is the customer service

number. Meanwhile, MARTA shelters and stations provide significant amounts of information from which trip plans and decisions can be made. The gap between bus stop signs and shelters is very wide.



| Atlanta | Low Info | High Info | Shelter | Station |
|---|---|---|---|---|
| Identification | | | | |
| Stop ID | | | | |
| Location Information | | | | |
| Stop Location | | | | |
| Bay Locations | | | | ltd. |
| "You Are Here" Map | | | | |
| Route Information | | | | |
| Route Numbers/Name | | | | |
| Direction | | | | |
| Route Map | | | | |
| Destination(s) | | | | |
| Connecting Routes | | | | |
| Scheduling Information | | | | |
| Days/Hours of Operation | | | | |
| Route Schedule | | | | |
| Frequency | | | | |
| Scheduled Next Bus - Electronic Board | | | | |
| Scheduled Next Bus - Text | | | | |
| Scheduled Next Bus - Web | | | | |
| Scheduled Next Bus - QR | | | | |
| Scheduled Next Bus - Call | | | | |
| Real-Time Next Bus - Electronic Board | | | | |
| Real-Time Next Bus - Text | | | | |
| Real-Time Next Bus - Web | | | | |
| Real-Time Next Bus - QR | | | | |
| Real-Time Next Bus - Call | | | | |
| System Information | | | | |
| System Map | | | | |
| POI Guide | | | | |
| General Information | | | | |
| Fare Information | | | | |
| Safety Information | | | | |
| Public Message Board | | | | |
| Revision Date | | | | |
| Website | | | | |
| Contact Information | | | | |
| Phone Number | | | | |
| TTY/TDD | | | | |
| Accessibility Information | | | | |
| Wheelchair Accessibility | | | | |
| Bicycle Accessibility | | | | |

## Austin, TX: Capital Metropolitan Transportation Authority (Capital Metro)

**Information System Hierarchy:** Three-Tier

**Tier 1:** Low Information Sign – Capital Metro provides an intensive and extensive passenger information system built on its detailed basic bus stop infrastructure. While many systems provide customer information numbers, route numbers, and a website url, Capital Metro goes far beyond this typical assortment by also displaying the stop location, different methods to determine when the next bus is expected to arrive, and a major destination on the route to indicate not only a POI, but also the direction of travel.

**Tier 2:** High Information Sign – Capital Metro adds to its intensive base with a bus stop sign with panels that further enhance the resources available to users. These panels include all of the attributes of the basic stop as well as stop-specific schedules, stop-specific diagrammatic maps with time and transfer points for the relevant routes, geographic 'you are here' maps, and fare information.

Tier 2 also includes shelters, which do not have walls, only offering protection from sun and steady rainfall. An issue with these shelter types is that they do not provide the agency with space on which to post any additional information beyond what can already be provided in the high information sign panels. As a result, Capital Metro does not provide any

more information at these stops other than the information that is provided at high information stops.

**Tier 3:** Station – Capital Metro does not have large multimodal stations; however, similar to other agencies in Texas, it utilizes a polycentric transfer center plan. These hubs are outdoors in expanded shelters that provide greater coverage to account for the increased traffic from the large number of routes that converge and layover at these points. Capital Metro has placed larger panels than those found in high information sign panels to convey more information to more people at one time. The larger panels also allow the agency to display a system map, which becomes increasingly important at points where many disparate routes join.

**Innovative elements**

- **Stop location –** Although stop location information can seem redundant with municipal signs that display street names, the information is an important resource in neighborhoods where municipal signs are rare or difficult to find. Furthermore, the information allows customer information agents a method of confirming locations of users along with unique stop ids.
- **Destination –** The display of the route destination provides a user, who is familiar with the area, with a context in which to begin constructing a cognitive map for a route. Moreover, the destination can also be a major

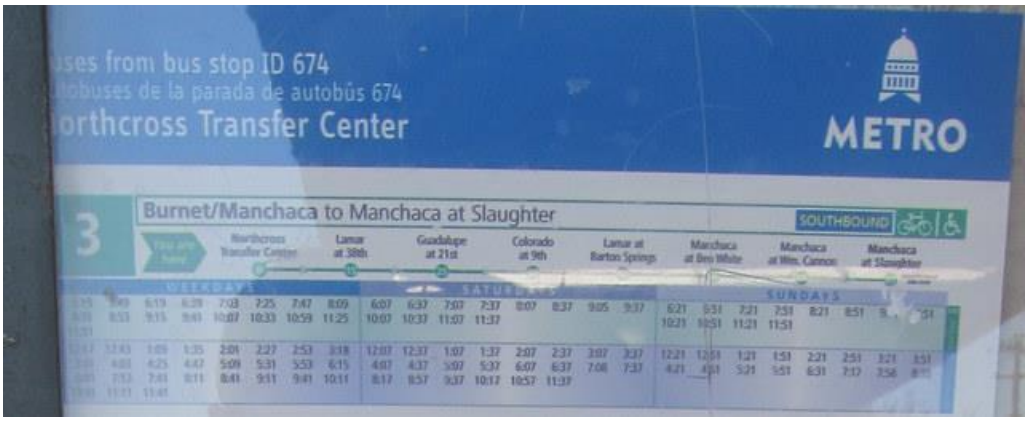
POI that may attract non-users into the system by providing the group with information that they would not otherwise seek on their own.

- **Stop-specific schedules paired with stop-specific diagrammatic route maps with accompanying time and transfer points –** Stop specificity removes a large obstacle for user comprehension of schedules and maps. Both users who are unfamiliar with an area and users with low schedule literacy may spend unnecessary amounts of time attempting to determine their location within the framework of the timetable or map. This can lead to user confusion and frustration. Stop-specific information allows users to skip this initial step in the process and only look for their destination. Similarly, diagrammatic maps reduce complexity for visualizing maps. The estimated travel times to time and transfer points on these maps allows the user to estimate their time of arrival, potentially reducing stress with a sense of certainty.
- **Scheduled next bus methods –** The panels offer users four methods (call, text, web, QR code) by which to find out when the next bus is scheduled to arrive. No other system offered, or at least advertised, as many ways to seek this same information. However, scheduled information is limited in its accuracy, depending on strong on-time performance (OTP). Nevertheless, the offering covers everyone with access to any type of mobile phone, 'basic', 'featured', or 'smart'. The use of remote information allows flexibility for modifications; for instance, should

Capital Metro begin using a GPS-based automatic vehicle locator (AVL) for next bus information, the transition will require fewer resources for adoption in the field.

**System Evaluation:** The information system is coherent from its most basic to most advanced bus stops. This can be attributed to heavy and well-planned investment in transit infrastructure that considers the needs of users throughout the system and responds to ridership with proportionately greater information.





| Austin | Low Info | High Info | Shelter | Station |
|---|---|---|---|---|
| Identification | | | | |
| Stop ID | | | | |
| Location Information | | | | |
| Stop Location | | | | |
| Bay Locations | | | | |
| "You Are Here" Map | | | | |
| Route Information | | | | |
| Route Numbers/Name | | | | |
| Direction | | | | |
| Route Map | | | | |
| Destination(s) | | | | |
| Connecting Routes | | | | |
| Scheduling Information | | | | |
| Days/Hours of Operation | | | | |
| Route Schedule | | | | |
| Frequency | | | | |
| Scheduled Next Bus - Electronic Board | | | | |
| Scheduled Next Bus - Text | | | | |
| Scheduled Next Bus - Web | | | | |
| Scheduled Next Bus - QR | | | | |
| Scheduled Next Bus - Call | | | | |
| Real-Time Next Bus - Electronic Board | | | | |
| Real-Time Next Bus - Text | | | | |
| Real-Time Next Bus - Web | | | | |
| Real-Time Next Bus - QR | | | | |
| Real-Time Next Bus - Call | | | | |
| System Information | | | | |
| System Map | | | | |
| POI Guide | | | | |
| General Information | | | | |
| Fare Information | | | | |
| Safety Information | | | | |
| Public Message Board | | | | |
| Revision Date | | | | |
| Website | | | | |
| Contact Information | | | | |
| Phone Number | | | | |
| TTY/TDD | | | | |
| Accessibility Information | | | | |
| Wheelchair Accessibility | | | | |
| Bicycle Accessibility | | | | |

## Birmingham, AL: Birmingham Jefferson County Transit Authority (BJCTA)

**Information System Hierarchy:** Two-Tier + Limited Service Type Enhancements

**Tier 1A:** Sign – BJCTA provides a basic sign, which identifies both regular sign stops as well as shelter stops. The sign includes the MAX logo as well as the motto, "It's time to ride!". Similar to many other agencies, BJCTA display the route numbers and names, the customer information number, and the website url. Finally, they include a handicap accessibility icon to indicate that the buses are handicap accessible. BJCTA uses these signs to identify both sign stops and shelter stops, which do not receive additional treatment.

**Tier 1B:** Circulator Sign – The circulator signs along the majority of the service area that they cover, provide a basic stop similar to that expressed in Tier 1A. The major difference is the prominence of the branding of the circulator routes. However, at the station, and possibly at other stops, a circulator panel, which specifies the stop, shows route maps, spans of service, and frequencies of the three circulator routes.

**Tier 2:** Station – BJCTA has one major station at which most of the routes terminate with a traditional radial system network. The station has a large schedule matrix that lists all of the routes and bus departure times. This format is both possible and manageable due to all routes at the station having a headway greater than or equal to thirty minutes, which means that all hours can be split into two boxes for each route since no

more than two trips by route will depart from the station within an hour. This reduces typical schedule complexity and makes the information clear and accessible to users at this hub. Passengers can acquire route and fare information from pamphlets inside the transit hub.

**System Evaluation:** The information system is basic, maintaining at least a minimum standard of information necessary for route identification. Route planning is difficult, if not impossible, to achieve without either calling customer information or appealing to the agency website. Radial networks, and hubs more generally, present excellent opportunities to dispense information to passengers, yet BJCTA has limited available information at this point.



| Birmingham | Low Info | High Info | Shelter | Station |
|---|---|---|---|---|
| Identification | | | | |
| Stop ID | | | | |
| Location Information | | | | |
| Stop Location | | | | |
| Bay Locations | | | | |
| "You Are Here" Map | | | | |
| Route Information | | | | |
| Route Numbers/Name | | | | |
| Direction | | | | |
| Route Map | circulator | circulator | circulator | |
| Destination(s) | | | | |
| Connecting Routes | | | | |
| Scheduling Information | | | | |
| Days/Hours of Operation | circulator | circulator | circulator | |
| Route Schedule | | | | |
| Frequency | circulator | circulator | circulator | |
| Scheduled Next Bus - Electronic Board | | | | |
| Scheduled Next Bus - Text | | | | |
| Scheduled Next Bus - Web | | | | |
| Scheduled Next Bus - QR | | | | |
| Scheduled Next Bus - Call | | | | |
| Real-Time Next Bus - Electronic Board | | | | |
| Real-Time Next Bus - Text | | | | |
| Real-Time Next Bus - Web | | | | |
| Real-Time Next Bus - QR | | | | |
| Real-Time Next Bus - Call | | | | |
| System Information | | | | |
| System Map | | | | |
| POI Guide | circulator | circulator | circulator | circulator |
| General Information | | | | |
| Fare Information | | | | |
| Safety Information | | | | |
| Public Message Board | | | | |
| Revision Date | | | | |
| Website | | | | |
| Contact Information | | | | |
| Phone Number | | | | |
| TTY/TDD | | | | |
| Accessibility Information | | | | |
| Wheelchair Accessibility | | | | |
| Bicycle Accessibility | | | | |

## Boston, MA: Massachusetts Bay Transportation Authority (MBTA)

**Information System Hierarchy:** Four-Tier

**Tier 1:** Low Information Sign – MBTA provides a compact sign as the foundation of its passenger information system for its bus network. Different from other agency's basic bus stop signs, MBTA provides the route number with the *destination* of that route alongside. Generically, route destination is often linked with the route name, which usually provides less useful information such as a name of some major destination on the route that may or may not be in the direction that one seeks to go, a name of a major street that the route serves, or even a legacy name with no bearing on the current route as is. The sign features a "T" and a bus icon and incorporates parking restriction information.

**Tier 2:** High Information Sign – At high ridership stops, MBTA enhances its basic bus stop signs with panels and, beginning with these stops, has begun to incorporate stop IDs and a TTY number into its basic bus stop sign. The panels add vast amounts of information including stop-specific schedules and stop-specific diagrammatic route maps with approximated time points and rail station transfer points. At very select stops, MBTA provides a cylindrical panel, which includes a geographic route map with connecting bus routes and rail lines, fare information, POI information, and information for accessing real-time next bus information in several formats.

**Tier 3:** Shelter – MBTA relies on the high information bus stop signs to provide the majority of passenger information in the bus system. However, the agency posts a system map on the back wall of shelters that have such a wall. The other unique information that shelters provide is a stop name that identifies the street on which the stop lies.

**Tier 4:** Station – Transit stations provide much of the extensive information covered at the other tiers, but do so in greater depth, utilizing the increased wall real estate available to post detailed schedules of all routes, detailed fare information, special notices, neighborhood maps, and geographic spider maps.

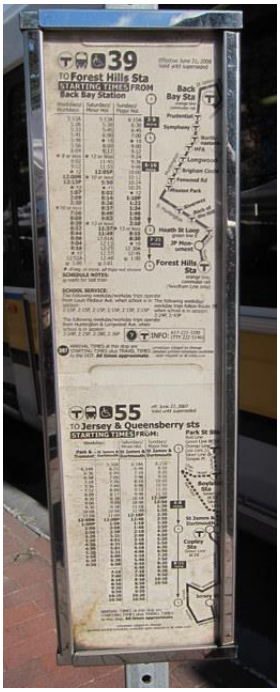
**Innovative elements**

- **Sign dimensions** – Unlike other transit systems, MBTA employs a tall and narrow basic bus stop sign. This format requires more text wrapping (or stacking), however; its shape is an immediate indicator to pedestrians of its identity. Moreover, since the sign is not double-sided, it only faces on-coming traffic. In this situation, pedestrians typically must guess if the backside of a sign is the backside of a bus stop sign, a parking sign, or any number of other street-side signs. However, the silhouette suggests its function without the added cost of fabricating a double-sided sign or an identical backside for the bus stop sign.

- **Parking Restriction Integration**– Many agencies have parking restrictions at their stops and post separate signs to that effect at each of them, MBTA efficiently reduces the number of signs it must manufacture by integrating parking restrictions at the bottom of each sign. While the agency could further reduce fabrication costs by posting that such a restriction prohibits parking 'X' number of feet in front of the sign, this may present legal challenges over whether people should be expected to be able to estimate a set number of feet. To avoid this issue, MBTA places another sign at the front of the restriction zone to identify precisely where a driver may not park.

**System Evaluation:** The information system is comprehensive and scales logically. While more information at the basic stops is desirable, the amount of information at the other tiers is above average and is available at the most heavily trafficked stops. Pragmatic investment of prioritizing the highest ridership stops over lower ridership stops is a boon to those areas which use transit the most and maximizes the initial audience of long-term system-wide improvements.


69 Harvard Station
617-222-3200
mbta.com
NO STANDING
TOW ZONE


39
TO Forest Hills Sta
STARTING TIMES FROM
Back Bay Station
55
TO Jersey & Queensberry sts
STARTING TIMES FROM:


AREA BUS SERVICE
FOREST HILLS STATION NEIGHBORHOOD MAP
T GREEN ST
FOREST HILLS STATION
BUS CONNECTIONS

| Boston | Low Info | High Info | Shelter | Station |
|---|---|---|---|---|
| **Identification** | | | | |
| Stop ID | | ltd. | ltd. | |
| **Location Information** | | | | |
| Stop Location | | | | |
| Bay Locations | | | | |
| "You Are Here" Map | | | | |
| **Route Information** | | | | |
| Route Numbers/Name | | | | |
| Direction | | | | |
| Route Map | | | | |
| Destination(s) | | | | |
| Connecting Routes | rail | rail | rail | |
| **Scheduling Information** | | | | |
| Days/Hours of Operation | | | | |
| Route Schedule | | +time2dest | +time2dest | |
| Frequency | | | | |
| Scheduled Next Bus - Electronic Board | | | | |
| Scheduled Next Bus - Text | | | | |
| Scheduled Next Bus - Web | | | | |
| Scheduled Next Bus - QR | | | | |
| Scheduled Next Bus - Call | | | | |
| Real-Time Next Bus - Electronic Board | | | | |
| Real-Time Next Bus - Text | | ltd. | ltd. | |
| Real-Time Next Bus - Web | | ltd. | ltd. | |
| Real-Time Next Bus - QR | | | | |
| Real-Time Next Bus - Call | | | | |
| **System Information** | | | | |
| System Map | | | ltd. | area bus svc |
| POI Guide | | ltd. | ltd. | |
| **General Information** | | | | |
| Fare Information | | ltd. | ltd. | |
| Safety Information | | | | |
| Public Message Board | | | | |
| Revision Date | | | | |
| Website | | | | |
| **Contact Information** | | | | |
| Phone Number | | | | |
| TTY/TDD | | | | |
| **Accessibility Information** | | | | |
| Wheelchair Accessibility | | | | |
| Bicycle Accessibility | | | | |

## Buffalo, NY: Niagara Frontier Transportation Authority (NFTA)

**Information System Hierarchy:** Two-Tier

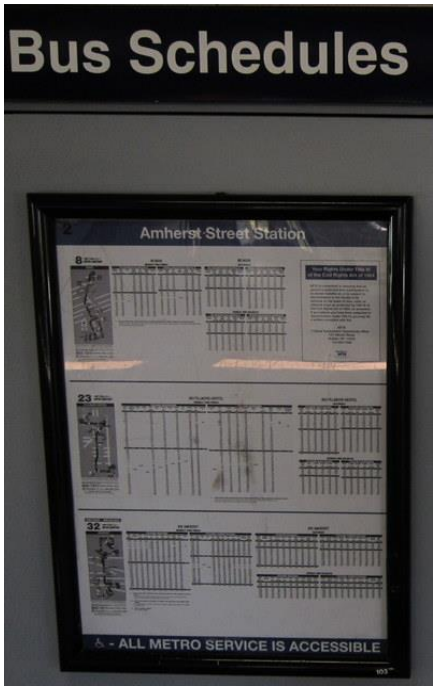
**Tier 1:** Sign – NFTA provides a basic sign, which identifies both regular sign stops as well as shelter stops. The sign includes the NFTA-Metro logo, two customer service numbers (TDD and regular), the website url, route numbers, and the route names. The sizing of the route number and route names varies depending on the number of routes that serve the stop. Bus stops use decals for route information. NFTA uses these signs as the primary information source at shelters as well.

**Tier 2:** Station – Transit stations provide schedule information with accompanying diagrammatic route maps with rail station transfer points, fare information, and (sometimes) a system map. A few stations are testing electronic boards to show next scheduled bus route information.

**System Evaluation:** The information system is basic, maintaining a bare minimum of information necessary for route identification. Route planning and navigation is difficult, if not impossible, to achieve without calling customer information or finding one of the few stations that has a system map. Furthermore, the lack of area codes attached to the customer information numbers reduces their utility for visitors. Non-relevant information such as zone numbers (when zone-based fares are not used) should be removed from bus stop signs as they may cause unnecessary confusion. With the website url

posted, NFTA should provide a system map online to allow people to learn where transit connections can be made for more efficient trip chaining.






| Buffalo | Low Info | High Info | Shelter | Station |
|---|---|---|---|---|
| Identification | | | | |
| Stop ID | | | | |
| Location Information | | | | |
| Stop Location | | | | |
| Bay Locations | | | | |
| "You Are Here" Map | | | | |
| Route Information | | | | |
| Route Numbers/Name | | | | |
| Direction | | | | |
| Route Map | | | | |
| Destination(s) | | | | |
| Connecting Routes | | | | rail |
| Scheduling Information | | | | |
| Days/Hours of Operation | | | | |
| Route Schedule | | | | |
| Frequency | | | | |
| Scheduled Next Bus - Electronic Board | | | | ltd. test |
| Scheduled Next Bus - Text | | | | |
| Scheduled Next Bus - Web | | | | |
| Scheduled Next Bus - QR | | | | |
| Scheduled Next Bus - Call | | | | |
| Real-Time Next Bus - Electronic Board | | | | |
| Real-Time Next Bus - Text | | | | |
| Real-Time Next Bus - Web | | | | |
| Real-Time Next Bus - QR | | | | |
| Real-Time Next Bus - Call | | | | |
| System Information | | | | |
| System Map | | | | |
| POI Guide | | | | |
| General Information | | | | |
| Fare Information | | | | |
| Safety Information | | | | |
| Public Message Board | | | | |
| Revision Date | | | | |
| Website | | | | |
| Contact Information | | | | |
| Phone Number | | | | |
| TTY/TDD | | | | |
| Accessibility Information | | | | |
| Wheelchair Accessibility | | | | |
| Bicycle Accessibility | | | | |

## Charlotte, NC: Charlotte Area Transit System (CATS)

**Information System Hierarchy:** Three-Tier + Limited Service Type Enhancements

**Tier 1A:** Low Information Sign – CATS provides a basic bus stop sign with the CATS logo, route numbers and names, and a customer information number. CATS also provides panels at all stops, which have schedules from that show departure times from the origins of each line and state destination of the route, the end of line. CATS utilizes shelters at both Tier 1 and Tier 2 stops, offering no additional information unless it has Sprinter service as noted in the following section.

**Tier 1B/2B:** Limited-Stop Service Sign – CATS has a limited-stop service that the agency calls "Sprinter". The bus stops on this route have specialized shelters that list all of the stops in a line. Where high information stops exist, in Uptown (downtown Charlotte), Sprinter panels utilize geographic route maps and expanded schedules that show approximate arrival times at several time points along the route. Otherwise, Sprinter stops use the same schedule panels that are used at low information stops as the service straddles both levels on its route between Uptown and the Airport.

**Tier 2A:** High Information Sign – Like several other agencies, CATS has premium downtown signage that adds more information than typical stops provide. These bus stops have multiple routes, which use the larger panels that these signs offer. Furthermore, the high information

signs include fare information, limited general information (such as a Lost & Found phone number), a TDD number, and a listing of times when handicap buses serve routes. Finally, where appropriate, these panels apply a geographic route map for the downtown circulator service. This route map serves as an area map with POIs as well.

**Tier 3:** Station – The stations and transit centers have some unique amenities that vary by location. CATS offers passengers next bus information on a number of electronic boards at bus bays and on monitors with accompanying bus bay maps throughout its advanced central station. The agency disseminates paper schedules with route maps at this location as well. The central station may be the only location in which a passenger can see a system map offline. Transit centers outside of Uptown have fewer resources, but still maintain bus bays and electronic boards.

**Innovative elements**

- **Scaling Signs** – CATS fabricates bus stop signs that scale based on the number of routes that serve a bus stop. Signs begin with a short style that can list up to two routes, which can be expanded to a tall style with four routes and doubled with a symmetrical sign for up to eight routes—a potential limitation for other systems. Yet, this scaling ensures a large uniform typeset that makes route numbers legible from a distance. Color-coded route types provide additional distance-based recognition.

**System Evaluation:** The available information system is clear at its foundational level, which applies to all stops throughout the system. However, since the schedules at bus stops are not stop-specific, reading them does not provide immediately useful information without knowing estimated times to stops from the respective ends of lines. Without route maps, this estimation is much more difficult. Moreover, there is an expectation of pre-planning built into the system since maps are not found outside of the central station and select stops. This limits the freedom of passengers to make informed decisions at stops or en route. Aesthetically, branding is strong and the sign styles are well-polished, particularly with the scaling, which brings a premium 'feel' to bus stops.


BUS ROUTES
Route 9S
NEXT TRIP 9:00P
10 WEST BLVD

| Charlotte | Low Info | High Info | Shelter | Station |
|---|---|---|---|---|
| Identification | | | | |
| Stop ID | internal | internal | internal | internal |
| Location Information | | | | |
| Stop Location | | | | |
| Bay Locations | | | | |
| "You Are Here" Map | | | | loc in stn |
| Route Information | | | | |
| Route Numbers/Name | | | | |
| Direction | | | | |
| Route Map | | ltd. srvcs | | ltd. srvcs |
| Destination(s) | | | | |
| Connecting Routes | | | | |
| Scheduling Information | | | | |
| Days/Hours of Operation | | | | |
| Route Schedule | | | | |
| Frequency | | | | |
| Scheduled Next Bus - Electronic Board | | | | |
| Scheduled Next Bus - Text | | | | |
| Scheduled Next Bus - Web | | | | |
| Scheduled Next Bus - QR | | | | |
| Scheduled Next Bus - Call | | | | |
| Real-Time Next Bus - Electronic Board | | | | |
| Real-Time Next Bus - Text | | | | |
| Real-Time Next Bus - Web | | | | |
| Real-Time Next Bus - QR | | | | |
| Real-Time Next Bus - Call | | | | |
| System Information | | | | |
| System Map | | | | main stn |
| POI Guide | | ltd. srvcs | | ltd. srvcs |
| General Information | | | | |
| Fare Information | | | | |
| Safety Information | | | | |
| Public Message Board | | | | |
| Revision Date | | | | |
| Website | | | | |
| Contact Information | | | | |
| Phone Number | | | | |
| TTY/TDD | | | | |
| Accessibility Information | | | | |
| Wheelchair Accessibility | | | | |
| Bicycle Accessibility | | | | |

## Chicago, IL: Chicago Transit Authority (CTA)

**Information System Hierarchy:** Three-Tier

**Tier 1:** Sign – CTA provides an advanced bus stop sign that displays many different types of information. If only one route serves the stop, CTA prints the route map directly onto the sign. If more than one route serves the stop, the information is placed in route numerical order. The agency provides a customized fit for each route for printing directly onto the sign rather than creating white space by using a standard size for all routes regardless of content. All signs come with a stop ID number for real-time next bus information via text.

**Tier 2:** Shelter – CTA relies on the sign to provide most of the information at shelters as well. However, some shelters also include large display panels for a system map that identifies the shelter location. These maps show both the bus and rail systems.

**Tier 3:** Station – The stations with dedicated bus infrastructure such as bus bays, include larger versions of the single route bus stop signs at each bay location. It is not verified as to whether or not a greater amount of scheduling information is provided.

**Innovative elements**

- **Route Map on Sign –** Unlike most agencies, which print route maps and place them in small panels, CTA prints route maps directly onto the sign. This endeavor has a high upfront cost but requires significantly less

maintenance than would the installation and upkeep of signpost panels. However, this decision is only possible for agencies with very high route stability. The time to customize the signs of each route and fabricate the sign has the potential to be extravagantly high as the signs must be switched whenever any change to the route is made. To limit exposure to this risk, CTA does not show connecting bus routes, only static rail lines.

**System Evaluation:** The design of the bus stop sign with a route map is a testament to the stability of the bus network. Furthermore, the customized signs and the electronic boards at some shelters point to the resources that the agency allocates to bus stop information. CTA is able to transfer a significant amount of information without the use of panels. While schedule information is missing, the inclusion of the real-time next bus information makes this information less necessary. Overall, the system is relatively simple and consistent and builds up reliable expectancies for passengers.


cta
bus stop
78 Montrose
Harlem 7200W
Irving Park 4000N
Oak Park 6800W
Forest Preserve Dr.
Reed Center 4200N
Blue Line (O'Hare) 4600W
Montrose 4400N
Brown Line 1800W
Clark
Wilson 4600N
Broadway
Red Line (Howard) 1200W
Clarendon
Marine Dr. 600W
Montrose Beach Service
Simonds
East to Montrose/Marine
Daily, early morning thru mid-evening
Service to Beach weekends and holidays,
Memorial Day Weekend thru Labor Day
TP 4908
TEXT CTABUS 11325 to 41411 for estimated arrival times
transitchicago.com (312) 836-7000 TTY (312) 836-4949


cta
bus stop
7 Harrison
West to Central/Harrison
Weekdays, early morning thru mid-evening
11 Lincoln/Sedgwick
South to Clinton Blue Line Station
Weekdays early morning thru early evening
126 Jackson
West to Jackson/Austin
Daily, early morning thru late evenings
Service to Stroger Cook County Hospital
Weekdays, late evenings and all day weekends
156 LaSalle
West to Desplaines/Harrison
Weekdays, early morning thru early evening
TP 6819
TEXT CTABUS 17649 to 41411 for estimated arrival times
transitchicago.com (312) 836-7000 TTY (312) 836-4949


81w West Lawrence
Service day and evening hours
No owl service
Cumberland station 5750N
West-Northwest rapid transit
Jefferson Park Transit Center 4917N 5400W
Cumberland 8400W
Harlem 7200W
Gunnison 4832N
Austin 6000W
Milwaukee
Lawrence 4800N


cta arrival times
9m
15m

| Chicago | Low Info | High Info | Shelter | Station |
|---|---|---|---|---|
| Identification | | | | |
| Stop ID | | | | |
| Location Information | | | | |
| Stop Location | | | | |
| Bay Locations | | | | |
| "You Are Here" Map | | | ltd | |
| Route Information | | | | |
| Route Numbers/Name | | | | |
| Direction | | | | |
| Route Map | 1bus@stop | 1bus@stop | 1bus@stop | 1bus@stop |
| Destination(s) | | | | |
| Connecting Routes | rail | rail | rail | rail |
| Scheduling Information | | | | |
| Days/Hours of Operation | approx. | approx. | approx. | approx. |
| Route Schedule | | | | no data |
| Frequency | | | | |
| Scheduled Next Bus - Electronic Board | | | | |
| Scheduled Next Bus - Text | | | | |
| Scheduled Next Bus - Web | | | | |
| Scheduled Next Bus - QR | | | | |
| Scheduled Next Bus - Call | | | | |
| Real-Time Next Bus - Electronic Board | | | ltd | |
| Real-Time Next Bus - Text | | | | |
| Real-Time Next Bus - Web | | | | |
| Real-Time Next Bus - QR | | | | |
| Real-Time Next Bus - Call | | | | |
| System Information | | | | |
| System Map | | | | |
| POI Guide | | | | |
| General Information | | | | |
| Fare Information | | | | |
| Safety Information | | | | |
| Public Message Board | | | | |
| Revision Date | | | | |
| Website | | | | |
| Contact Information | | | | |
| Phone Number | | | | |
| TTY/TDD | | | | |
| Accessibility Information | | | | |
| Wheelchair Accessibility | | | | |
| Bicycle Accessibility | | | | |

## Dallas, TX: Dallas Area Rapid Transit (DART)

**Information System Hierarchy:** Three-Tier

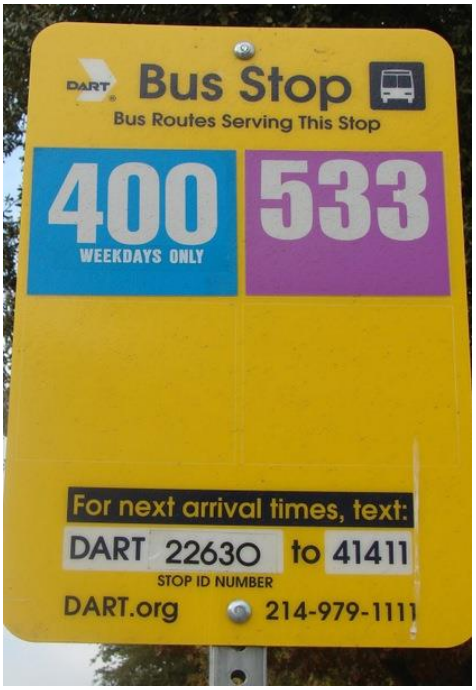
**Tier 1: Low Information** Sign – DART provides a standard sign, which identifies both regular sign stops as well as shelter stops. The sign has a bright yellow field that matches the color scheme of the agency. DART uses decals at most stops; it prints onto signs with very many routes. The decals show the bus route number, service type by color, and indicate any service limitations. Prominently at the bottom of the sign is the text for next bus information with the accompanying stop ID. This is followed by the website url and the customer service information phone number.

**Tier 2:** High Information Sign – DART adds a four-sided panel to a limited number of stops. These signs are also used at shelters, which offer no further information. The panel supplies the user with schedules and, when space is available, a route map and fare information. The route map panels feature a similar design to those found at the other Texas transit agencies with a diagrammatic map with estimated travel times followed by the schedule.

**Tier 3:** Station – DART stations have large kiosks that layout the station map, a relatively small-scale area map, and schedules. At the bays, the high information bus stop signs are used.

**System Evaluation:** The information is clear and the signage is easy to recognize with the well-integrated branding of the infrastructure. However, at the low

information sign level, user information is minimal—it is enough to work, but not enough to plan unless a user already knows which routes serve which areas. Above this level, signs that incorporate maps supply users with the necessities to move about the system.







| Dallas | Low Info | High Info | Shelter | Station |
|---|---|---|---|---|
| Identification | | | | |
| Stop ID | | | | |
| Location Information | | | | |
| Stop Location | | | | |
| Bay Locations | | | | |
| "You Are Here" Map | | | | |
| Route Information | | | | |
| Route Numbers/Name | | | | |
| Direction | | | | |
| Route Map | | ltd | ltd | |
| Destination(s) | | | | |
| Connecting Routes | | ltd | ltd | |
| Scheduling Information | | | | |
| Days/Hours of Operation | ltd svc rts | ltd svc rts | ltd svc rts | |
| Route Schedule | | | | |
| Frequency | | | | |
| Scheduled Next Bus - Electronic Board | | | | |
| Scheduled Next Bus - Text | | | | |
| Scheduled Next Bus - Web | | | | |
| Scheduled Next Bus - QR | | | | |
| Scheduled Next Bus - Call | | | | |
| Real-Time Next Bus - Electronic Board | | | | |
| Real-Time Next Bus - Text | | | | |
| Real-Time Next Bus - Web | | | | |
| Real-Time Next Bus - QR | | | | |
| Real-Time Next Bus - Call | | | | |
| System Information | | | | |
| System Map | | downtown | downtown | |
| POI Guide | | | | |
| General Information | | | | |
| Fare Information | | ltd | ltd | |
| Safety Information | | | | |
| Public Message Board | | | | |
| Revision Date | | | | |
| Website | | | | |
| Contact Information | | | | |
| Phone Number | | | | |
| TTY/TDD | | | | |
| Accessibility Information | | | | |
| Wheelchair Accessibility | | | | |
| Bicycle Accessibility | | | | |

## Denver, CO: Regional Transportation District – Denver (RTD)

**Information System Hierarchy:** Two-Tier+ Limited Service Type Enhancements

**Tier 1A:** Sign – RTD provides a basic bus stop sign as the core feature of its passenger information system at both sign stops and shelter stops. This sign has two different faces, one face, called “My Ride” to clarify that its information is route specific, includes the typical amount of information at this level including route names and numbers, a customer information number, and a website url. The other face, called “My Stop” to clarify that its information is stop specific, includes a stop ID number from which passengers can acquire scheduled next bus information by phone.

**Tier 1B:** Limited Shelters – RTD produces large displays for some of its shelters, mostly limited to Downtown. These displays have abundant amounts of information, far beyond what exists throughout the majority of the system. They represent investment in transit features within the downtown area, where the most network complexity exists. However, shelters outside of Downtown retain only the bus stop sign mentioned in Tier 1A as the sole information source, creating a stark disparity in information by location.

**Tier 2:** Station – Stations and park-n-rides provide the same levels of information in Denver. Both types of facilities work as hubs for a number of routes. RTD provides stations with the maps mentioned in Tier 1B.

Where these maps cannot fit, RTD splits the information on the map by route and places them in four-sided panels adjacent to the appropriate bus stop.

**Innovative elements**

- **Bifacial Sign –** This bifacial sign is unlike most bus stop signs, transit agencies usually fabricate signs with one side with a metallic backside or two identical sides. The "My Ride" and "My Stop" signs employ similar maroon rounded rectangular decals as their base. This cohesion should allow passengers to identify the stops without issue regardless of which side of the sign they are facing. Meanwhile, the subtle difference allows RTD to display more information using less space with the assumption that a passenger can move to the other side of the sign if they are looking for information not found on the side facing them.
- **Stop Lettering –** RTD utilizes letters (eg X, Y, Z) to identify stops block-by-block along certain streets in downtown Denver. This system improves operational efficiency by limiting the number of buses that stop at each block in a transit-congested area. It also offers a clear distinction between bus stops for passengers and indicates to them that each stop is served by different bus routes; and therefore, they should not to expect all buses to stop at each location. Passengers can confirm this characteristic by comparing the routes on "The Ride" signs of each bus stop.

- **Bus Bay Maps –** RTD prints bus bay (known as “gates” in Denver) maps to accompany route maps at RTD-owned facilities with large numbers of bays. These maps are similar to terminal maps at airports with gates; both work to reduce the complexity that exists due to the large number of choices. These maps not only show where particular bays are located, but also list the assignments to each bay so that a passenger can glance at this map and list to find out where they need to go to board their respective bus.

**System Evaluation:** The information system is easy to understand and with transit hubs throughout the region and in downtown Denver, access to high-quality information is not excessively distant. This presents a rational model for disseminating a high level of information across an expansive service area.


MY STOP
13367
RTD
For next arrival call
303.299.6000
RTD-Denver.com


The Ride
79L
5x
O
87x
OLtd
3L
83Ltd
100X
116x
ES
16
CX
P


Park-n-Ride
Westbound
AIRPORT BLVD & 40TH AVENUE park-n-Ride
Airport Blvd & 40th Ave park-n-Ride
Gate Assignments
From DIA
To DIA
North
skyRide Overflow Gates


The Ride
9
20
15
15Ltd
X STOP
X

| Denver | Low Info | High Info | Shelter | Station |
|---|---|---|---|---|
| Identification | | | | |
| Stop ID | | | | |
| Location Information | | | | |
| Stop Location | | | ltd. | |
| Bay Locations | | | | |
| "You Are Here" Map | | | | |
| Route Information | | | | |
| Route Numbers/Name | | | | |
| Direction | | | | |
| Route Map | | | ltd. | |
| Destination(s) | | | ltd. | |
| Connecting Routes | | | ltd. | |
| Scheduling Information | | | | |
| Days/Hours of Operation | | | ltd. | |
| Route Schedule | | | ltd. | |
| Frequency | | | ltd. | |
| Scheduled Next Bus - Electronic Board | | | | lmt. stns |
| Scheduled Next Bus - Text | | | | |
| Scheduled Next Bus - Web | | | | |
| Scheduled Next Bus - QR | | | | |
| Scheduled Next Bus - Call | | | | |
| Real-Time Next Bus - Electronic Board | | | | |
| Real-Time Next Bus - Text | | | | |
| Real-Time Next Bus - Web | | | | |
| Real-Time Next Bus - QR | | | | |
| Real-Time Next Bus - Call | | | | |
| System Information | | | | |
| System Map | | | | |
| POI Guide | | | ltd. | |
| General Information | | | | |
| Fare Information | | | ltd. | |
| Safety Information | | | | |
| Public Message Board | | | | |
| Revision Date | | | ltd. | |
| Website | | | | |
| Contact Information | | | | |
| Phone Number | | | | |
| TTY/TDD | | | | |
| Accessibility Information | | | | |
| Wheelchair Accessibility | | | ltd. | |
| Bicycle Accessibility | | | | |

## Ft Lauderdale, FL: Broward County Transit (BCT)

**Information System Hierarchy:** One-Tier + Limited Service Type Enhancements

**Tier 1A:** Sign – BCT provides a basic bus stop sign as its sole information resource throughout its system with the rare exception of the trolley sign, which is described in Tier 1B. BCT displays route numbers without accompanying route names, accessibility information, and a customer information number at stops.

**Tier 1B:** Trolley Sign – BCT supplements standard bus service with a few trolley circulator routes. All of these stops include a special sign that lists the trolley "line" that serves it. Moreover, the shelter bus stops include a trolley route map in a large panel with POIs, a schedule, and fare information (for the trolleys).

**Innovative elements**

- **Handicap-Accessibility Decal –** BCT uses a decal to identify handicap-accessible *stops*. This is separate from handicap-accessible decals that represent handicap-accessible buses, which are far more common in major North American transit systems. This application comes with some inherent risk should stops with these decals become non-compliant. Nevertheless, this application feels more appropriate and significantly more useful to handicap passengers, particularly when all buses in a system are handicap-accessible, in which case the need for this knowledge is reduced to a first experience. The use of the decal to

identify bus stops for bus-related purposes only becomes relevant and useful when select stops have handicap-accessible buses.

- **System Evaluation:** The information system is limited by the single tier. BCT has few options when it does not make use of shelters or Tri-Rail stations to present greater amounts of information. These choices make navigation and use of the system difficult without pre-planning or the use of remote resources such as Google Transit. To an extent, BCT relies on familiarity with its transit-amenable street network with mostly north-south corridors to guide trips.


| Ft Lauderdale | Low Info | High Info | Shelter | Station |
|---|---|---|---|---|
| Identification | | | | |
| Stop ID | | | | |
| Location Information | | | | |
| Stop Location | | | | |
| Bay Locations | | | | |
| "You Are Here" Map | | | | |
| Route Information | | | | |
| Route Numbers/Name | | | | |
| Direction | | | | |
| Route Map | | | trolley | trolley |
| Destination(s) | | | | |
| Connecting Routes | | | | |
| Scheduling Information | | | | |
| Days/Hours of Operation | | | trolley | trolley |
| Route Schedule | | | | |
| Frequency | | | trolley | trolley |
| Scheduled Next Bus - Electronic Board | | | | |
| Scheduled Next Bus - Text | | | | |
| Scheduled Next Bus - Web | | | | |
| Scheduled Next Bus - QR | | | | |
| Scheduled Next Bus - Call | | | | |
| Real-Time Next Bus - Electronic Board | | | | |
| Real-Time Next Bus - Text | | | | |
| Real-Time Next Bus - Web | | | | |
| Real-Time Next Bus - QR | | | | |
| Real-Time Next Bus - Call | | | | |
| System Information | | | | |
| System Map | | | | |
| POI Guide | | | trolley | trolley |
| General Information | | | | |
| Fare Information | | | trolley | trolley |
| Safety Information | | | | |
| Public Message Board | | | | |
| Revision Date | | | | |
| Website | | | | |
| Contact Information | | | | |
| Phone Number | | | | |
| TTY/TDD | | | | |
| Accessibility Information | | | | |
| Wheelchair Accessibility | | | | |
| Bicycle Accessibility | | | | |

## Fresno, CA: Fresno Area Express (FAX)

**Information System Hierarchy:** Two-Tier

**Tier 1:** Sign – FAX provides a recently updated, yet very basic bus stop sign. It features the word "Bus" along with a large bus icon, the agency name, and a customer information number (without an area code). Below these signs are attached route signs that have decals of the route numbers that serve the respective stop.

While redundancy is often beneficial for wayfinding purposes as a means of offering passengers a sense of confidence in times of uncertainty, the large bus icon restricts the useful space of the bus stop sign that is essentially just a flag.

**Tier 2:** Station – FAX has much infrastructure at the stops in Downtown that together make up the central station for the transit agency. These bus stops have route numbers and names, which reflect the major streets that each route serves, with clearly and overtly stated frequencies for the days of the week. Other than next bus information, the only additional information that is missing from the station is an area map with POIs for the neighborhood. This would benefit passengers whose destination is downtown Fresno.

**System Evaluation:** The information system is lacking overall. Route numbers are ambiguous without more detail. Route names, while sometimes misleading, can at least hint at route direction and utility. FAX takes advantage of its radial

network to share extensive amounts of information at its downtown station, but poor maintenance of the panels at the location makes smaller print items such as the system map difficult to read. Thus, whereas trip planning is near-impossible outside of the central station without calling for information or searching for the website online, it could be easy in Downtown with improved upkeep. Nevertheless, the system likely discourages new or casual ridership with its deficiency of information.



| Fresno | Low Info | High Info | Shelter | Station |
|---|---|---|---|---|
| Identification | | | | |
| Stop ID | | | | |
| Location Information | | | | |
| Stop Location | | | | |
| Bay Locations | | | | |
| "You Are Here" Map | | | | |
| Route Information | | | | |
| Route Numbers/Name | | | | |
| Direction | | | | |
| Route Map | | | | |
| Destination(s) | | | | |
| Connecting Routes | | | | |
| Scheduling Information | | | | |
| Days/Hours of Operation | | | | |
| Route Schedule | | | | |
| Frequency | | | | |
| Scheduled Next Bus - Electronic Board | | | | |
| Scheduled Next Bus - Text | | | | |
| Scheduled Next Bus - Web | | | | |
| Scheduled Next Bus - QR | | | | |
| Scheduled Next Bus - Call | | | | |
| Real-Time Next Bus - Electronic Board | | | | |
| Real-Time Next Bus - Text | | | | |
| Real-Time Next Bus - Web | | | | |
| Real-Time Next Bus - QR | | | | |
| Real-Time Next Bus - Call | | | | |
| System Information | | | | |
| System Map | | | | |
| POI Guide | | | | |
| General Information | | | | |
| Fare Information | | | | |
| Safety Information | | | | |
| Public Message Board | | | | |
| Revision Date | | | | |
| Website | | | | |
| Contact Information | | | | |
| Phone Number | | | | |
| TTY/TDD | | | | |
| Accessibility Information | | | | |
| Wheelchair Accessibility | | | | |
| Bicycle Accessibility | | | | |

Houston, TX: Metropolitan Transit Authority of Harris County (Metro)

**Information System Hierarchy:** Three-Tier

**Tier 1:** Sign – Metro provides a customizable sign. It has three base elements: the Metro logo, Metro Police contact information, and a customer information number with the agency website url. Additionally, Metro attaches route information between these elements using a standard bracket that allows up to four routes in addition to the base elements of the sign.

**Tier 2:** Shelter – Metro bus stop shelter build-quality varies widely between Downtown stops and non-Downtown stops. Yet, both build types present comparable amounts of information, albeit at a different scale. Downtown shelters include four-sided kiosks with large-scale route maps, which are built into Downtown area maps, and route identification signs. Whereas, outside of downtown Houston, all of the same information is scaled down to the Metro bus stop sign and a large decal affixed to the shelter. Rather than a Downtown area map though, the panel shows stop-specific route maps with "You are here" points along them. They also state the direction at which buses at the stop will be headed.

**Tier 3:** Station – Similar to other Texas-based transit agencies, Metro uses a polycentric transfer center plan, which allows Metro to reach out to many passengers to disseminate vast amounts of passenger information.

These stations present information with large panels. Metro posts large schedules for each route with the appropriate time point highlighted for quick access to departure times. Metro also posts its system map with POIs for trip planning. Rather than print bus bay maps, Metro places wayfinding signs throughout stations to guide passengers to desired bays. Finally, Metro locates its off-board fare machines at stations, where passengers can add value to their smartcards.

**Innovative elements**

- **Individual Sign Sheets per Route –** Metro is one of only a few transit agencies to post bus stop signs whose size are customizable based on the precise number of bus routes that serve each stop. This allows Metro to print route information signs in large quantities and place them as appropriate. Furthermore, this allows the agency to add more information as resources become available without revamping the entire signage system, making it flexible to modifications decreasing potential capital costs of improvements. Drawbacks are potentially increased labor costs of fabrication compared with decals and typeset size constraints based on the height and width of each standard route information sign sheet.

**System Evaluation:** The information system is cohesive throughout the service area. Although bus stop signs currently lack much desirable information, the scaling of information at shelters and stations sufficiently supplements the

information that is made available. As such, Metro takes advantage of an efficient transit plan to reach more passengers with fewer invested resources. An inability to access next bus information—or not advertising that ability—is surprising in such a large market.



| Houston | Low Info | High Info | Shelter | Station |
|---|---|---|---|---|
| Identification | | | | |
| Stop ID | | | | |
| Location Information | | | | |
| Stop Location | | | | |
| Bay Locations | | | | |
| "You Are Here" Map | | | | |
| Route Information | | | | |
| Route Numbers/Name | | | | |
| Direction | exp rts | exp rts | | |
| Route Map | | | | |
| Destination(s) | | | | |
| Connecting Routes | | | | |
| Scheduling Information | | | | |
| Days/Hours of Operation | | | | |
| Route Schedule | | | | |
| Frequency | | | | |
| Scheduled Next Bus - Electronic Board | | | | |
| Scheduled Next Bus - Text | | | | |
| Scheduled Next Bus - Web | | | | |
| Scheduled Next Bus - QR | | | | |
| Scheduled Next Bus - Call | | | | |
| Real-Time Next Bus - Electronic Board | | | | |
| Real-Time Next Bus - Text | | | | |
| Real-Time Next Bus - Web | | | | |
| Real-Time Next Bus - QR | | | | |
| Real-Time Next Bus - Call | | | | |
| System Information | | | | |
| System Map | | | | |
| POI Guide | | | | |
| General Information | | | | |
| Fare Information | | | | fare type |
| Safety Information | | | | |
| Public Message Board | | | | |
| Revision Date | | | | |
| Website | | | | |
| Contact Information | | | | |
| Phone Number | | | | |
| TTY/TDD | | | | |
| Accessibility Information | | | | |
| Wheelchair Accessibility | | | | |
| Bicycle Accessibility | | | | |

## Los Angeles, CA: Los Angeles County Metropolitan Transportation Authority (LACMTA)

**Information System Hierarchy:** Three-Tier + Limited Service Type Enhancements

**Tier 1A:** Low Information Sign – LACMTA provides a basic customizable sign, which can be found at all tiers. This sign incorporates route numbers, service type, route destinations, and days of operation when not regular.

**Tier 1B:** Additional Next Bus and Frequency Information - Some of the low information sign bus stops include a real-time next bus information panel that shows users four different ways of retrieving the information through remote resources. Some of these stops also have a frequency decal for a select route, which offers an estimate of the current headway between buses at different times throughout the day.

**Tier 2:** High Information Sign – LACMTA uses four-sided panels on Metro Rapid routes, which provide limited stop service. These routes serve and consequently these signs exist at transfer points and major intersections. These panels have route maps with connecting buses and frequency information that is formatted in the same way that the frequency decal in the low information sign tier is formatted

**Tier 3:** Station – LACMTA only adds a bay locations map at some stations. Other display cases exist but have been left empty. The high information sign is installed at relevant bays for the user.

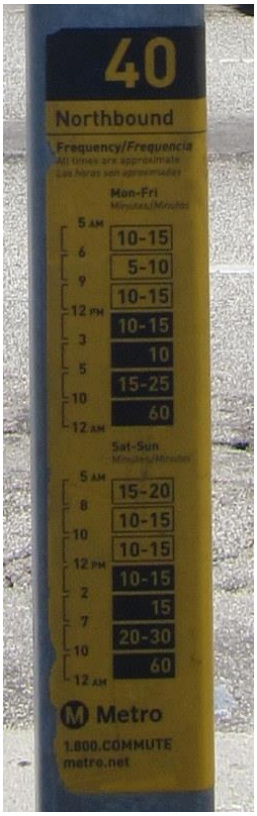
**Innovative elements**

- **Frequency Decal** – LACMTA does not use schedules at its bus stops; rather, the agency relies on shorter and less complex frequency tables. While these tables are route dependent and cannot allow a user to estimate the time when a bus will arrive if they have not yet seen a bus pass, they give a user a sense of how long they should expect to wait at most. Schedules are often unwieldy, even for regular users. Frequency tables simplify the schedule and, to an extent, avoid the problem of providing an estimated bus stop time at a non-time point. Moreover, because frequency tables are much more condensed, LACMTA prints them on decals to place directly on the signpost, lowering the installation and maintenance costs that would otherwise exist with infrastructure such as a signpost panel.

**System Evaluation:** The information system is cohesive, though inconsistent from stop to stop. At paired stops, one stop may have a frequency decal when its pair does not, despite having the same service. Similarly, the real-time next bus information signs are placed sporadically across the system with no seemingly logical method of placement along routes. These issues make the information system hit-or-miss unless a user is at a high information bus stop. Once these additions sources of information are placed throughout the system, it will be much easier to plan travel thanks to the cardinal grid street network.


Metro
40
Downtown LA Union Station
442
Downtown LA Union Station


NEXTRIP
323.GO.METRO
metro.net
Text "metro 5176" to 41411
m.metro.net
511, say "Nextrip"
STOP#
5176
Metro


40
Northbound
Frequency/Frecuencia
Mon-Fri
5 AM 10-15
6 5-10
9 10-15
12 PM 10-15
3 10
5 15-25
10 60
12 AM
Sat-Sun
5 AM 15-20
8 10-15
10 10-15
12 PM 10-15
2 15
7 20-30
10 60
12 AM
Metro
1.800.COMMUTE
metro.net


Metro
40
111
111
311
311
442
607
740


Metro
40
Metro Local
Inglewood
So Bay Center
111
Metro Local
LAX City Bus
Center
111
Metro Local
Norwalk Green
Line Station
311
Metro Local
LAX City Bus
Center
311
442
607
740


Metro Rapid
740
Hawthorne
Southbound/al sur
N
Metro

| Los Angeles | Low Info | High Info | Shelter | Station |
|---|---|---|---|---|
| Identification | | | | |
| Stop ID | ltd stops | ltd stops | ltd stops | ltd stops |
| Location Information | | | | |
| Stop Location | | | | |
| Bay Locations | | | | |
| "You Are Here" Map | | | | |
| Route Information | | | | |
| Route Numbers/Name | | | | |
| Direction | ltd rts | rapid rts | rapid rts | rapid rts |
| Route Map | | rapid rts | rapid rts | rapid rts |
| Destination(s) | | | | |
| Connecting Routes | | rapid rts | rapid rts | rapid rts |
| Scheduling Information | | | | |
| Days/Hours of Operation | ltd svc rts | ltd svc rts | ltd svc rts | ltd svc rts |
| Route Schedule | | | | |
| Frequency | ltd rts | rapid rts | rapid rts | rapid rts |
| Scheduled Next Bus - Electronic Board | | | | |
| Scheduled Next Bus - Text | | | | |
| Scheduled Next Bus - Web | | | | |
| Scheduled Next Bus - QR | | | | |
| Scheduled Next Bus - Call | | | | |
| Real-Time Next Bus - Electronic Board | | | | |
| Real-Time Next Bus - Text | ltd stops | ltd stops | ltd stops | ltd stops |
| Real-Time Next Bus - Web | ltd stops | ltd stops | ltd stops | ltd stops |
| Real-Time Next Bus - QR | ltd stops | ltd stops | ltd stops | ltd stops |
| Real-Time Next Bus - Call | ltd stops | ltd stops | ltd stops | ltd stops |
| System Information | | | | |
| System Map | | | | |
| POI Guide | | | | |
| General Information | | | | |
| Fare Information | | | | |
| Safety Information | | | | |
| Public Message Board | | | | |
| Revision Date | | | | |
| Website | ltd stops | | | |
| Contact Information | | | | |
| Phone Number | ltd stops | | | |
| TTY/TDD | | | | |
| Accessibility Information | | | | |
| Wheelchair Accessibility | | | | |
| Bicycle Accessibility | | | | |

## Memphis, TN: Memphis Area Transit Authority (MATA)

**Information System Hierarchy:** Three-Tier + Limited Service Type Enhancements

**Tier 1:** Low Information Sign – MATA provides a basic bus stop sign as its primary infrastructure for much of its system. These signs are in a period of transition as MATA applies decals to them to give customers more information at all stops. Currently, the lowest level of information provided by MATA at these stops includes a bus icon, the words "Bus Stop", a customer information number, and the website url for the agency.

**Tier 2A:** High Information Sign – As mentioned in the prior section, MATA is adding a decal to its stops. This decal includes a stop ID, a website url that links to customer information web tools, and a method to find the next bus arrival time by texting. Very rare, perhaps only initiated as a demonstration project in the past, is a stop with panels that includes a route map and schedule.

**Tier 2B:** Express Route Sign – MATA fabricates a modified sign for express routes. This sign is a different color, blue rather than green, and explicitly states that it is an "Express Bus Stop" to explain that the respective route is a different service type. Moreover, MATA prints the route number and name onto the sign as well.

**Tier 3:** Station – MATA relies heavily on pamphlets at its transit centers. These provide the bulk of the information available at the station.

However, MATA has a static sign in the bay area with the route numbers and their respective destinations. Additionally, they installed a LCD television inside the waiting area of the station with the same information as well as the real-time next bus departure estimates.

**Innovative elements**

- **Decal for Improved Information** - To improve its customer information system, MATA applies a decal over the words "Bus Stop" on its low information signs. This replaces a somewhat useful element, which serves to assure customers of the purpose of the sign, with a decal that provides a significantly higher level of information. A transit agency should identify its stops either by words or by universal icons and the bus icon that MATA uses at its stops is proficient for this purpose. As a result, MATA can free up some of the space on its signs for a higher and better use. This is a low-cost alternative to sign replacement and is a viable option for many transit agencies whose budgets do not allow for a sign redesign and fabrication process.

**System Evaluation:** The information system is limited, but improving, though with a reliance on remote resources. MATA lacks route numbers, a key basic element for low-level information systems, at most stops. Moreover, with little route information outside of stations and the push to the website url on its decals, there is an expectation of pre-planning being built into the system. This

limits the freedom of passengers to make informed decisions at stops or en route. While remote resources are useful, they provide supplemental information, not *all* information.



| Memphis | Low Info | High Info | Shelter | Station |
|---|---|---|---|---|
| Identification | | | | |
| Stop ID | | | | |
| Location Information | | | | |
| Stop Location | | | | |
| Bay Locations | | | | |
| "You Are Here" Map | | rare | | |
| Route Information | | | | |
| Route Numbers/Name | | exp rts | exp rts | |
| Direction | | | | |
| Route Map | | rare | | |
| Destination(s) | | rare | | |
| Connecting Routes | | rare | | |
| Scheduling Information | | | | |
| Days/Hours of Operation | | rare | | |
| Route Schedule | | rare | | |
| Frequency | | rare | | |
| Scheduled Next Bus - Electronic Board | | | | |
| Scheduled Next Bus - Text | | | | |
| Scheduled Next Bus - Web | | | | |
| Scheduled Next Bus - QR | | | | |
| Scheduled Next Bus - Call | | | | |
| Real-Time Next Bus - Electronic Board | | | | |
| Real-Time Next Bus - Text | | | | |
| Real-Time Next Bus - Web | | | | |
| Real-Time Next Bus - QR | | | | |
| Real-Time Next Bus - Call | | | | |
| System Information | | | | |
| System Map | | | | |
| POI Guide | | | | |
| General Information | | | | |
| Fare Information | | | | |
| Safety Information | | | | |
| Public Message Board | | | | |
| Revision Date | | | | |
| Website | | | | |
| Contact Information | | | | |
| Phone Number | | | | |
| TTY/TDD | | | | |
| Accessibility Information | | | | |
| Wheelchair Accessibility | | rare | | |
| Bicycle Accessibility | | rare | | |

## Miami, FL: Miami-Dade Transit (MDT)

**Information System Hierarchy:** Two-Tier

**Tier 1:** Sign – MDT provides a high information bus stop as the backbone of its passenger information system. This stop exists at all stops, including stations. These stops have panels with route information, and when room allows, fare information and web, phone, and TDD contact information. Above the panel is the route information, which utilizes decals applied to a metal sheet with a green field. The sheets come in custom sizes to fit a set number of route decals. MDT bus stop signs have much more information than basic bus stop signs that make up the bulk of other large transit systems. A limited number of shelters have system maps, but the majority of shelters remain completed reliant on the high information bus stop sign; this does not go far enough to justify the designation of a third tier.

**Tier 2:** Station – MDT adds to its base at stations, where the agency posts schedule and system information. Stations with dedicated bus bays also have bus bay maps; however, this system breaks down in downtown Miami where the number of buses exceeds the space available in bays. The absence of accompanying area maps makes it difficult to determine the location of bus stop locations for specific routes. As a result, people must ask other passengers or operators, or find station agents to request assistance in a search for a stop location.

**Innovative elements**

- **Elongated Route Information Decal –** Printing decals is a less expensive alternative to printing new signs for improving and/or updating customer information at bus stops. Decals are an aesthetic trade-off to printing though, as they deteriorate at a different rate than the sheet metal, peel, and look sloppy when carelessly applied. However, for systems with insufficient funds for a sign redesign, decals offer an opportunity to present large amounts of information on vacant or inefficient sign space.

**System Evaluation:** The information system is strong at the sign tier, but lacks an appreciable jump in information before stations. This leads to a system that lacks schedule information throughout much of the system. Nevertheless, with respect to the information that MDT does provide, the decals are well-designed and the inclusion of panels offers significant space for advanced information.

| Miami | Low Info | High Info | Shelter | Station |
|---|---|---|---|---|
| Identification | | | | |
| Stop ID | | | | |
| Location Information | | | | |
| Stop Location | | | | |
| Bay Locations | | | | |
| "You Are Here" Map | | | | |
| Route Information | | | | |
| Route Numbers/Name | | | | |
| Direction | | | | |
| Route Map | | | | |
| Destination(s) | | | | |
| Connecting Routes | rail | rail | rail | rail |
| Scheduling Information | | | | |
| Days/Hours of Operation | irreg hrs | irreg hrs | irreg hrs | |
| Route Schedule | | | | |
| Frequency | | | | |
| Scheduled Next Bus - Electronic Board | | | | |
| Scheduled Next Bus - Text | | | | |
| Scheduled Next Bus - Web | | | | |
| Scheduled Next Bus - QR | | | | |
| Scheduled Next Bus - Call | | | | |
| Real-Time Next Bus - Electronic Board | | | | |
| Real-Time Next Bus - Text | | | | |
| Real-Time Next Bus - Web | | | | |
| Real-Time Next Bus - QR | | | | |
| Real-Time Next Bus - Call | | | | |
| System Information | | | | |
| System Map | | | ltd | |
| POI Guide | | | | |
| General Information | | | | |
| Fare Information | | | | |
| Safety Information | | | | |
| Public Message Board | | | | |
| Revision Date | | | | |
| Website | | | | |
| Contact Information | | | | |
| Phone Number | | | | |
| TTY/TDD | | | | |
| Accessibility Information | | | | |
| Wheelchair Accessibility | | | | ltd |
| Bicycle Accessibility | | | | |

## Minneapolis, MN: Metro Transit

**Information System Hierarchy:** Three-Tier

**Tier 1:** Sign – Metro Transit provides a basic bus stop sign that lacks any information other than to identify itself as a bus stop. However, at those bus stops with high frequency routes, Metro Transit posts a second sign with all route numbers and labels the high frequency route in red. They are in the process of conducting a pilot study with stop ID numbers at select stops as a potential addition to signs system-wide.

**Tier 2:** Shelter – Metro Transit offers customer information at new shelters. Older shelters only have the basic bus stop sign. The new shelters have a panel for "Transit Information" which includes scheduled arrival times for the buses that service the respective bus stop.

**Tier 3:** Station – Metro Transit adds much more passenger information at the station tier. This tier includes designated "Transit Centers" as well as its Marquette and 2nd Avenue (Marq2) transit corridor. Stations have numerous panels for location information, system or Downtown maps, scheduling information, and contact information. The Marq2 corridor also includes electronic boards with next bus arrival times.

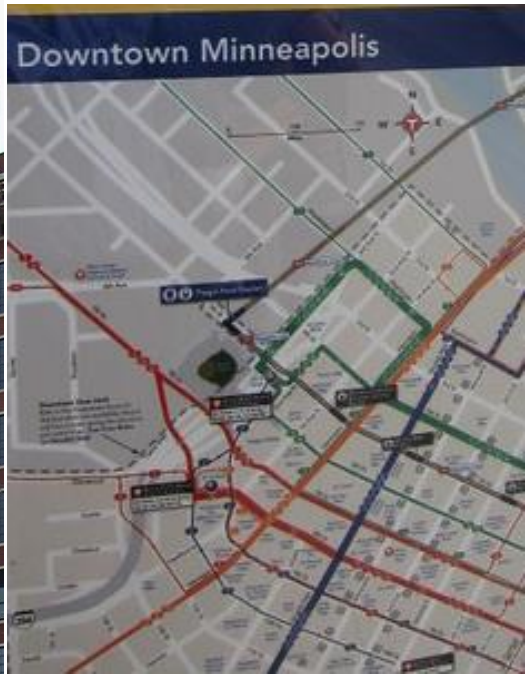
**Innovative elements**

- **High Frequency Flag**

  Metro Transit indicates stops that serve high frequency routes with bright red signs next to its basic bus stop sign. These flags draw attention

to highly reliable service on users should be able to depend with the hope of attracting ridership to these routes.

**System Evaluation:** The basic bus stop sign has the least information of any conducted in this survey. The system is completely reliant on pre-planning and/or remote resources. While this may not be an issue for habitual riders, it constrains the ability of riders to make efficient decisions when they must make trips without pre-planning or access to smartphones. Furthermore, with little information, passengers cannot confirm locations, times, or any other information. This confirmation can only take place at certain shelters or at stations. Similar to the transit agencies in Texas, Metro Transit uses hubs to deliver large amounts of information; while the hubs are distributed relatively evenly across the system, the coverage does not approach a level that could justify not providing any information at basic bus stops and many shelters.

| Minneapolis | Low Info | High Info | Shelter | Station |
|---|---|---|---|---|
| Identification | | | | |
| Stop ID | | | | |
| Location Information | | | | |
| Stop Location | | | | |
| Bay Locations | | | | |
| "You Are Here" Map | | | | |
| Route Information | | | | |
| Route Numbers/Name | hi-freq rts | hi-freq rts | ltd | |
| Direction | | | | |
| Route Map | | | | |
| Destination(s) | | | ltd | |
| Connecting Routes | | | | |
| Scheduling Information | | | | |
| Days/Hours of Operation | | | ltd | |
| Route Schedule | | | ltd | |
| Frequency | | | ltd | |
| Scheduled Next Bus - Electronic Board | | | | |
| Scheduled Next Bus - Text | | | | |
| Scheduled Next Bus - Web | | | | |
| Scheduled Next Bus - QR | | | | |
| Scheduled Next Bus - Call | | | | |
| Real-Time Next Bus - Electronic Board | | | | |
| Real-Time Next Bus - Text | | | | |
| Real-Time Next Bus - Web | | | | |
| Real-Time Next Bus - QR | | | | |
| Real-Time Next Bus - Call | | | | |
| System Information | | | | |
| System Map | | | | |
| POI Guide | | | | |
| General Information | | | | |
| Fare Information | | | | |
| Safety Information | | | | |
| Public Message Board | | | | |
| Revision Date | | | | |
| Website | | | no data | |
| Contact Information | | | | |
| Phone Number | | | no data | |
| TTY/TDD | | | | |
| Accessibility Information | | | | |
| Wheelchair Accessibility | | | | |
| Bicycle Accessibility | | | | |

## Montreal, QC: Société de Transport de Montréal (STM)

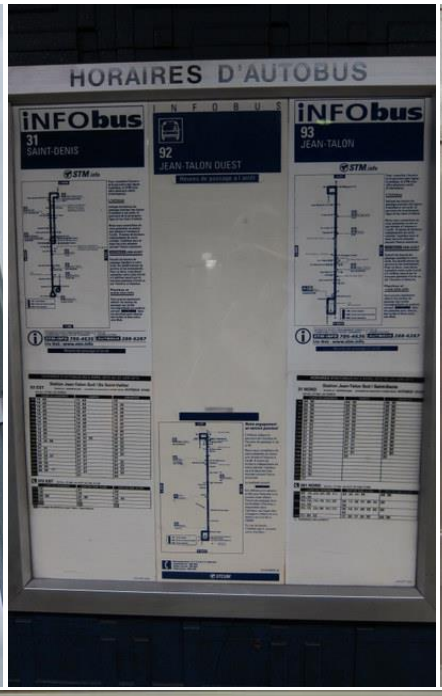
**Information System Hierarchy:** Three-Tier

**Tier 1:** Sign – STM provides a basic bus stop sign that provides route numbers, notification of night and limited day service, headways for frequent service routes, route connections to rail stations, wheelchair accessibility, customer information phone number, and a stop ID. The sign is a standard size, while the space that each route number takes up is set to expand or contract to automatically fit the sign. This usage of space requires the fabrication of new signs with any changes and precludes the use of decals. The signs are used at all tiers.

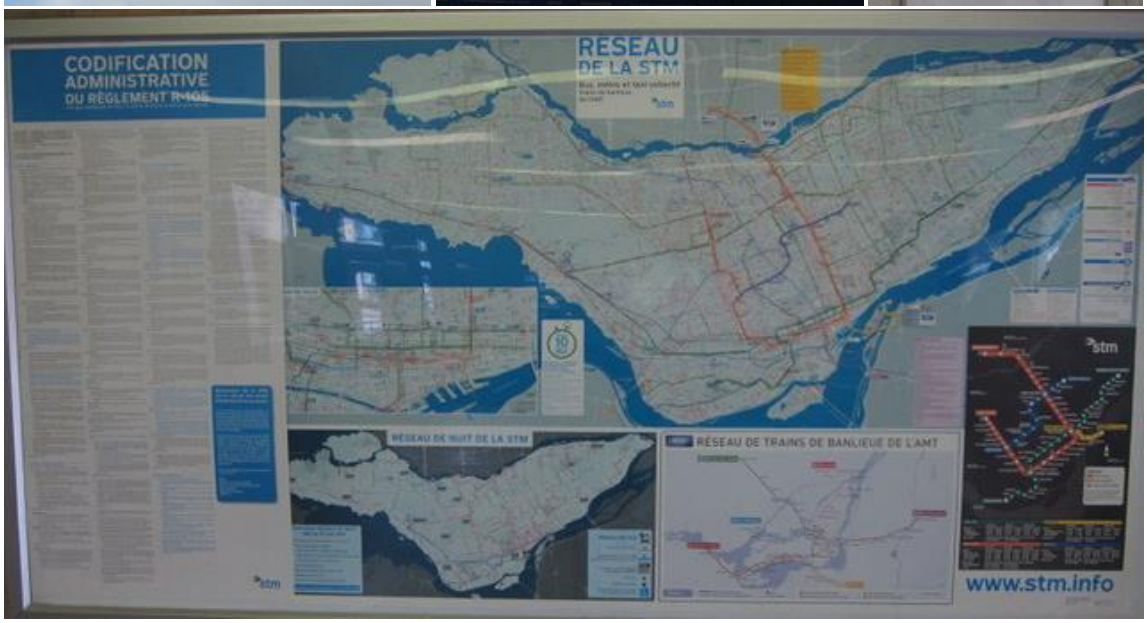
**Tier 2:** High Information Stop – STM utilizes a single-sided signpost panel to display additional user information including a small, but detailed route map, a route schedule, and special fares. The route map shows POIs and connecting bus routes. The route schedules notes the direction of travel, the destination, in addition to the timetable and when it was last revised.

**Tier 3:** Station – STM relies on its multimodal transit station infrastructure, which focuses on the rail network. These stations lack bays and so typically have curbside stops similar to a standard bus stop. However, many of the system maps next to rail platforms incorporate both the bus and rail networks. Also, all station locations are readily identified.

**System Evaluation:** The user information system that STM provides is strong as long as a user can find their location with assistance from other street signage. The all-in effort to print onto signs gives a clean appearance to signs and the sign panels are well-designed to offer much information in little space. Typeface size is small though, making reading difficult for those with vision impairment.





| Montreal | Low Info | High Info | Shelter | Station |
|---|---|---|---|---|
| Identification | | | | |
| Stop ID | | | | |
| Location Information | | | | |
| Stop Location | | | | |
| Bay Locations | | | | |
| "You Are Here" Map | | | | |
| Route Information | | | | |
| Route Numbers/Name | | | | |
| Direction | | | | |
| Route Map | | | | |
| Destination(s) | | | | |
| Connecting Routes | rail | rail | rail | rail |
| Scheduling Information | | | | |
| Days/Hours of Operation | Ltd/night | | | |
| Route Schedule | | | | |
| Frequency | hi-freq rts | | | |
| Scheduled Next Bus - Electronic Board | | | | |
| Scheduled Next Bus - Text | | | | |
| Scheduled Next Bus - Web | | | | |
| Scheduled Next Bus - QR | | | | |
| Scheduled Next Bus - Call | | | | |
| Real-Time Next Bus - Electronic Board | | | | |
| Real-Time Next Bus - Text | | | | |
| Real-Time Next Bus - Web | | | | |
| Real-Time Next Bus - QR | | | | |
| Real-Time Next Bus - Call | | | | |
| System Information | | | | |
| System Map | | | | |
| POI Guide | | | | |
| General Information | | | | |
| Fare Information | | Special | Special | |
| Safety Information | | | | |
| Public Message Board | | | | |
| Revision Date | | | | |
| Website | | | | |
| Contact Information | | | | |
| Phone Number | | | | |
| TTY/TDD | | | | |
| Accessibility Information | | | | |
| Wheelchair Accessibility | | | | |
| Bicycle Accessibility | | | | |

## Nashville, TN: Nashville Metropolitan Transit Authority (Nashville MTA)

**Information System Hierarchy:** Three-Tier

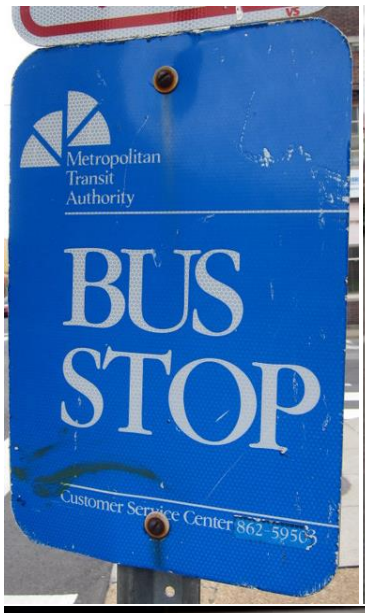
**Tier 1:** Sign – Nashville MTA provides a barebones sign that says "BUS STOP", lists a customer information number, and the agency name. This is insufficient for users. Downtown Nashville employs a Circulator route that has its own signage that is much improved over the typical bus stop sign. It includes basic information to assist decision-making for short trips through and around the CBD.

**Tier 2:** Shelter – Nashville MTA adds only route numbers as additional information to typical shelters; however, BRT shelters have large pylons where the agency posts route information including a map with POIs. Furthermore, the BRT shelters are named like stations on a rail line and are identified as such.

**Tier 3:** Station – The main transit center displays the system map alongside pamphlets with all of the route and scheduling information. This is similar to MATA, the other Tennessee site, and its decision to transfer the bulk of its information in this manner.

**System Evaluation:** Nashville MTA has a useful high information sign that the agency uses at some stops along its brt routes; however, the number of these that exist in the system is very low, limiting their utility. Other than these high information signs, the remainder of the typical bus stop signs lack necessary information for trip-making. Without picking up schedule and route information

pamphlets at the transit center, users *must* call the customer information number to have any idea as to when the next bus will arrive and where it will go. The system needs significant investment to meet minimum standards for travel.






| Nashville | Low Info | High Info | Shelter | Station |
|---|---|---|---|---|
| Identification | | | | |
| Stop ID | | | | |
| Location Information | | | | |
| Stop Location | | | brtstopname | |
| Bay Locations | | | | |
| "You Are Here" Map | | | | |
| Route Information | | | | |
| Route Numbers/Name | | | | |
| Direction | | | | |
| Route Map | circulator | | brt | |
| Destination(s) | | | brt | |
| Connecting Routes | | | brt | |
| Scheduling Information | | | | |
| Days/Hours of Operation | circulator | | | |
| Route Schedule | | | | |
| Frequency | circulator | | | |
| Scheduled Next Bus - Electronic Board | | | | |
| Scheduled Next Bus - Text | | | | |
| Scheduled Next Bus - Web | | | | |
| Scheduled Next Bus - QR | | | | |
| Scheduled Next Bus - Call | | | | |
| Real-Time Next Bus - Electronic Board | | | | |
| Real-Time Next Bus - Text | | | | |
| Real-Time Next Bus - Web | | | | |
| Real-Time Next Bus - QR | | | | |
| Real-Time Next Bus - Call | | | | |
| System Information | | | | |
| System Map | | | | |
| POI Guide | circulator | | brt | |
| General Information | | | | |
| Fare Information | circulator | circulator | | |
| Safety Information | | | | |
| Public Message Board | | | | |
| Revision Date | circulator | | | |
| Website | circulator | | | |
| Contact Information | | | | |
| Phone Number | | | | |
| TTY/TDD | | | | |
| Accessibility Information | | | | |
| Wheelchair Accessibility | | | | |
| Bicycle Accessibility | | | | |

## New York, NY: MTA New York City Transit (NYCT)

**Information System Hierarchy:** Two-Tier

**Tier 1:** Sign – The sign and accompanying four-sided panel is the foundation of the intensive NYCT information system. These two pieces of infrastructure exist at nearly all stops at all tiers in the system. They include all essential information except a TTY/TDD number and a system map. The signs are made of high-quality construction materials, easily visible with a large typeface. The four-sided panels have detailed route maps as well as other information that varies by panel depending on the number of routes that serve the stop.

**Tier 2:** Station – In addition to the signs and four-sided panels from Tier 1, NYCT places system maps in large display panels in rail stations, on which they add the missing TTY/TDD information and safety information. The information found at stations incorporates up all applicable information elements that can be found in transit systems.

**Innovative elements**

- **Guide-A-Rides (four-sided panels)**

  NYCT makes extensive use of four-sided panels, which the agency refers to as "GARs" or Guide-A-Rides. GARs are found in a number of transit systems, but only OC Transpo in Ottawa, ON uses them as widely as NYCT. GARs at bus stops with only one bus provide space for very high levels of information not commonly found in even the best information

systems in this survey. The consistently high level of information provides assurance to users that they will have the resources to reach their destination with the given information without relying on external sources. This affords users with a greater sense of independence. While GARs can be expensive to install and maintain, NYCT leverages their benefits to the highest and best use possible.

**System Evaluation:** NYCT has an advanced high-quality user information system built on bus stop signs and GARs. With the information disseminated to all bus stops, a user can make efficient trip decisions from anywhere throughout the system. Trip planning can be completed at any one of the hundreds of rail stations, where borough-centric system maps can be found. MTA and NYCT have invested significant sums of money into the system, effectively assuring that the largest transit agency in North America feels simple and manageable to users.


NO STANDING
M7 Harlem
B38 Bushwick
BxM7 Co-op City
S98 LTD Mariners Harbor
M2 Washington Heights
NIGHT SERVICE ONLY
SI East 34 St Ferry Terminal
Q1 Jamaica
SHUTTLE Bus Stop
NO STANDING 7 AM - 4 PM School Days
9/11 MEMORIAL Tour Buses Pick Up/ Drop Off Only
Greenwich Av & Christopher St

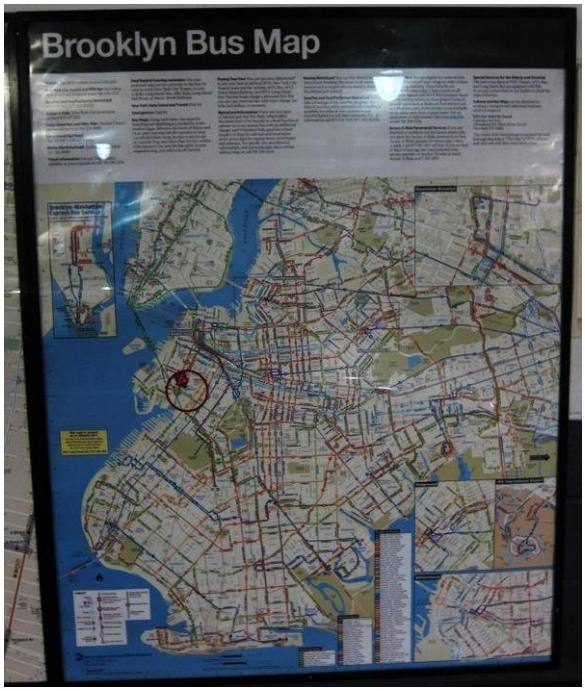

MTA Bus Time
& BUS SCHEDULE
S6292
Know when your bus will arrive here!
Weekday
Saturday
Sunday


M5


BUS STOP SCHEDULE
M05


BUS STOP
NO STANDING


Trip tips
Fare
MetroCard
Transfers
Map
Schedule
For Everyone's Comfort
Travel Information
Filing a Title VI complaint


Brooklyn Bus Map

| New York | Low Info | High Info | Shelter | Station |
|---|---|---|---|---|
| Identification | | | | |
| Stop ID | | | | |
| Location Information | | | | |
| Stop Location | | | | |
| Bay Locations | | | | |
| "You Are Here" Map | ltd maps | ltd maps | ltd maps | |
| Route Information | | | | |
| Route Numbers/Name | | | | |
| Direction | | | | |
| Route Map | | | | |
| Destination(s) | | | | |
| Connecting Routes | | | | |
| Scheduling Information | | | | |
| Days/Hours of Operation | | | | |
| Route Schedule | | | | |
| Frequency | | | | |
| Scheduled Next Bus - Electronic Board | | | | |
| Scheduled Next Bus - Text | | | | |
| Scheduled Next Bus - Web | | | | |
| Scheduled Next Bus - QR | | | | |
| Scheduled Next Bus - Call | | | | |
| Real-Time Next Bus - Electronic Board | | | | |
| Real-Time Next Bus - Text | | | | |
| Real-Time Next Bus - Web | | | | |
| Real-Time Next Bus - QR | | | | |
| Real-Time Next Bus - Call | | | | |
| System Information | | | | |
| System Map | | | | |
| POI Guide | | | | |
| General Information | | | | |
| Fare Information | 1bus@stop | 1bus@stop | 1bus@stop | 1bus@stop |
| Safety Information | | | | |
| Public Message Board | | | | |
| Revision Date | | | | |
| Website | 1bus@stop | 1bus@stop | 1bus@stop | 1bus@stop |
| Contact Information | | | | |
| Phone Number | 1bus@stop | 1bus@stop | 1bus@stop | 1bus@stop |
| TTY/TDD | | | | |
| Accessibility Information | | | | |
| Wheelchair Accessibility | | | | |
| Bicycle Accessibility | 1bus@stop | 1bus@stop | 1bus@stop | 1bus@stop |

## Ottawa, ON: Ottawa-Carleton Regional Transit Commission (OC Transpo)

**Information System Hierarchy:** Two-Tier

**Tier 1:** Sign – OC Transpo provides an advanced bus stop sign as the foundation of its information system. The sign includes the stop ID and the customer information number by which users can find next bus information. The sign has route numbers and the agency website. The signpost also holds a four-sided panel, which contains the bulk of local information, with route and schedule information as well as wheelchair accessibility information. A limited number of bus stops, which can have at most one bus that serves them, include a panel dedicated to general and contact information.

**Tier 2:** Station – OC Transpo has stations that are multi-modal, serving rail and buses as well as uni-modal, serving buses along its transitways. OC Transpo posts all applicable information elements in different places in both of these types of stations. Unlike many transit agencies, OC Transpo does not use their typical sign at stations, but replaces them with larger signs and display panels for better visibility.

**System Evaluation:** While OC Transpo does not provide any particularly innovative element, the transit agency provides a very strong overall information system for users. The many resources that it provides are clear, concise, and easy to find with the red accents. Moreover, the tiers are effective with a solid

base-level tier that is built upon using more space that is available at high-level tiers. Trip-making is an easy process with such high levels of information.


| Ottawa | Low Info | High Info | Shelter | Station |
|---|---|---|---|---|
| Identification | | | | |
| Stop ID | | | | |
| Location Information | | | | |
| Stop Location | | | | |
| Bay Locations | | | | |
| "You Are Here" Map | | | | |
| Route Information | | | | |
| Route Numbers/Name | | | | |
| Direction | | | | |
| Route Map | | | | |
| Destination(s) | | | | |
| Connecting Routes | brtway/lrt | brtway/lrt | brtway/lrt | brtway/lrt |
| Scheduling Information | | | | |
| Days/Hours of Operation | | | | |
| Route Schedule | | | | |
| Frequency | | | | |
| Scheduled Next Bus - Electronic Board | | | | |
| Scheduled Next Bus - Text | | | | |
| Scheduled Next Bus - Web | | | | |
| Scheduled Next Bus - QR | | | | |
| Scheduled Next Bus - Call | | | | |
| Real-Time Next Bus - Electronic Board | | | | |
| Real-Time Next Bus - Text | | | | |
| Real-Time Next Bus - Web | | | | |
| Real-Time Next Bus - QR | | | | |
| Real-Time Next Bus - Call | | | | |
| System Information | | | | |
| System Map | | | | |
| POI Guide | ltd | ltd | ltd | |
| General Information | | | | |
| Fare Information | ltd | ltd | ltd | |
| Safety Information | hotline | hotline | hotline | |
| Public Message Board | | | | |
| Revision Date | | | | |
| Website | | | | |
| Contact Information | | | | |
| Phone Number | | | | |
| TTY/TDD | ltd | ltd | ltd | |
| Accessibility Information | | | | |
| Wheelchair Accessibility | | | | |
| Bicycle Accessibility | | | | |

## Philadelphia, PA: Southeastern Pennsylvania Transportation Authority (SEPTA)

**Information System Hierarchy:** Three-Tier + Limited Service Type Enhancements

**Tier 1A:** Sign – SEPTA uses a basic bus stop sign with contact information, the website url, stop ID, and route numbers and their respective destinations. The route numbers have a high contrast with a white typeface on a black field and they are printed directly onto the sign.

**Tier 1B:** Trolley Sign – SEPTA trolley signage in the city center is built for visitors, with a large route map and POI guide. The sign also includes more utilitarian information such as the fare and scheduling information. It is separate from the typical bus stop signs as trolley numbers are not posted on the Tier 1A signs.

**Tier 2:** Shelter – SEPTA does not use the basic bus stop sign for shelters; instead, it posts this information directly onto shelter frames. SEPTA adds stop location and frequency information in this manner. In stops found in the city center, Ride!Philadelphia maps are placed in some large display panels. These are route maps with POIs that use the same design scheme as the Walk!Philadelphia maps, which make up a comprehensive city-wide pedestrian signage system.

**Tier 3:** Station – SEPTA stations improve on shelter information to provide full route schedules and, as applicable, bay location maps. They have much more dedicated infrastructure that allows information to be

posted in display panels rather than on frames and, thus, make the information larger and more legible for users.

**Innovative elements**

- **Use of Shelter Frame**

  SEPTA posts route numbers, stop location, and frequency information directly on to shelter frames. This frees up the little space that remains in some shelters—mostly found in the city center—to display more robust route information with the inclusion of detailed "You Are Here" route maps, which are developed in coordination with the city's large pedestrian sign system, Walk!Philadelphia.

**System Evaluation:** The system scales well from the basic sign through the stations. The basic bus stop sign lacks scheduling information which may be an impediment for users, particularly outside of the city center, where shelters are less common. However, stations are abundant and while not all stations are equal, especially those not built to be multi-modal stations, the jump in the level of information that exists around them, typically brings the scheduling information that is missing on basic signs. The most glaring issue is the lack of a bus system map, which makes trip planning difficult to achieve other than on a route-by-route basis and with an already well-constructed cognitive map of the city.


SEPTA
TDD/TTY: 215-580-7853
215-580-7800 www.septa.org
17 PENNS LANDING
Front & Market Streets
Average Time Between Buses
33 PENNS LANDING
Front & Chestnut Streets
Average Time Between Buses
44 INDEPENDENCE MALL
5th & Market Streets
Average Time Between Buses
48 PENNS LANDING
Front & Market Streets
Average Time Between Buses
See Timetable


MARKET STREET Eastbound Buses
17 33 44 48 121
Ride! PHILADELPHIA


SEPTA
www.septa.org
215-580-7800
TTD/TTY:
215-580-7853
17 Front-Market
33 Penn's Landing
44 5th-Market
48 Front-Market
STOP I.D. #10331


SEPTA 31, 32, 33, 38, 44, 62, 124, 125
MANN
LESTER LOOP
TITAN 215-268-0073
0025

| Philadelphia | Low Info | High Info | Shelter | Station |
|---|---|---|---|---|
| Identification | | | | |
| Stop ID | | | | |
| Location Information | | | | |
| Stop Location | | | | |
| Bay Locations | | | | |
| "You Are Here" Map | | | city center | city center |
| Route Information | | | | |
| Route Numbers/Name | | | | |
| Direction | | | city center | city center |
| Route Map | | trolley | city center | city center |
| Destination(s) | | | | |
| Connecting Routes | | | city center | city center |
| Scheduling Information | | | | |
| Days/Hours of Operation | | trolley | | |
| Route Schedule | | | | |
| Frequency | | trolley | | |
| Scheduled Next Bus - Electronic Board | | | | |
| Scheduled Next Bus - Text | | | | |
| Scheduled Next Bus - Web | | | | |
| Scheduled Next Bus - QR | | | | |
| Scheduled Next Bus - Call | | | | |
| Real-Time Next Bus - Electronic Board | | | | |
| Real-Time Next Bus - Text | | | | |
| Real-Time Next Bus - Web | | | | |
| Real-Time Next Bus - QR | | | | |
| Real-Time Next Bus - Call | | | | |
| System Information | | | | |
| System Map | | | | |
| POI Guide | | trolley | city center | |
| General Information | | | | |
| Fare Information | | trolley | | |
| Safety Information | | | | |
| Public Message Board | | | | |
| Revision Date | | | | |
| Website | | | | |
| Contact Information | | | | |
| Phone Number | | | | |
| TTY/TDD | | | | |
| Accessibility Information | | | | |
| Wheelchair Accessibility | ltd | ltd | ltd | ltd |
| Bicycle Accessibility | | | | |

## Pittsburgh, PA: Port Authority of Allegheny County (Port Authority)

**Information System Hierarchy:** Three-Tier

**Tier 1:** Sign – Port Authority installs a very basic bus stop sign that says "BUS STOP" and lists route numbers and names separately below it. These signs are used at all stops.

**Tier 2:** Shelter – The agency applies the nearest at street location to the outside of shelters and the on street to the inside of shelters. It also has room in some shelters for small displays; in one case Port Authority posted safety information.

**Tier 3:** Station – Stations offer users schedule information; however, the downtown subway stations were closed during the site visit, so it is not known if those stations offer more beyond what the Pittsburgh busway stations offer.

**System Evaluation:** Other than the presence of route numbers and names on the bus stop signs, the system is difficult to use due to the lack of other necessary elements. Outside of stations and away from the Port Authority customer service center, it is virtually impossible to find out how to move through the system. Not availing contact information prevents even the most basic form of remote resource retrieval and given the absence of local resources, uncertainty for irregular users and visitors is likely to be quite high. More information is necessary.


Bus
Stop
61C McKspt.-Homestead
61D Summerset
64 Lawrenceville-Waterfront


Forbes Ave.
Bus Stop

| Pittsburgh | Low Info | High Info | Shelter | Station |
|---|---|---|---|---|
| Identification | | | | |
| Stop ID | | | | no data |
| Location Information | | | | |
| Stop Location | | | | no data |
| Bay Locations | | | | |
| "You Are Here" Map | | | | |
| Route Information | | | | |
| Route Numbers/Name | | | | |
| Direction | | | | no data |
| Route Map | | | | |
| Destination(s) | | | | |
| Connecting Routes | | | | |
| Scheduling Information | | | | |
| Days/Hours of Operation | | | | |
| Route Schedule | | | | |
| Frequency | | | | |
| Scheduled Next Bus - Electronic Board | | | | no data |
| Scheduled Next Bus - Text | | | | |
| Scheduled Next Bus - Web | | | | |
| Scheduled Next Bus - QR | | | | |
| Scheduled Next Bus - Call | | | | |
| Real-Time Next Bus - Electronic Board | | | | |
| Real-Time Next Bus - Text | | | | |
| Real-Time Next Bus - Web | | | | |
| Real-Time Next Bus - QR | | | | |
| Real-Time Next Bus - Call | | | | |
| System Information | | | | |
| System Map | | | | no data |
| POI Guide | | | | |
| General Information | | | | |
| Fare Information | | | | no data |
| Safety Information | | | rare | |
| Public Message Board | | | | |
| Revision Date | | | | |
| Website | | | | |
| Contact Information | | | | |
| Phone Number | | | | no data |
| TTY/TDD | | | | |
| Accessibility Information | | | | |
| Wheelchair Accessibility | | | | no data |
| Bicycle Accessibility | | | | |

## Portland, OR: Tri-County Metropolitan Transportation District of Oregon (TriMet)

**Information System Hierarchy:** Four-Tier + Limited Service Type Enhancements

**Tier 1:** Low Information Sign – TriMet uses a basic bus stop sign that includes the fare zone, route number, destination, three methods to acquire next bus information using remote resources and the attached stop ID. This sign is used at locations outside of the core downtown area.

**Tier 2:** High Information Sign – TriMet also builds signposts with panels of varying sizes customized for the number of routes that serve a bus stop. The panel states the stop location, provides route maps, days of operation, and accessibility information. In the downtown core are, it also provides the methods for acquiring next bus information using remote resources and the stop ID. Signs with larger panels due to the stops serving more routes include a safety message and a QR code.

**Tier 3:** Shelter – Shelters incorporate the same information as high information signs but present this information in large display panels on the shelter, or when that is not possible, on signposts in the same manner as high information signs. Shelters are differentiated from high information signs in that they have posted schedules.

**Tier 4:** Station – TriMet has built a multi-modal transit mall in downtown Portland that leverages the advantages of light rail and bus to allow both to run along the same right of way, thereby making more efficient use of resources and allowing the agency to enhance stops along the mall

substantially. These stops have electronic boards that display the next bus information for appropriate to that stop. TriMet supplies system maps at these stops, but does not provide schedules.

**System Evaluation:** TriMet delivers a coherent and comprehensive information system, particularly at its urban core. The lack of a system map at most stops may hamper trip planning while and the agency relies on remote resources for schedule information at most of its stops; however, making use of the system is relatively straightforward. The system is well-planned and scales well to account for higher ridership area, affording more users with higher levels of information. It delivers several innovative elements; however, these have already been mentioned for other agencies (see Austin and Minneapolis).

| Portland | Low Info | High Info | Shelter | Station |
|---|---|---|---|---|
| Identification | | | | |
| Stop ID | | | | |
| Location Information | | | | |
| Stop Location | | | | |
| Bay Locations | | | | |
| "You Are Here" Map | | | | |
| Route Information | | | | |
| Route Numbers/Name | | | | |
| Direction | | | | |
| Route Map | | | | |
| Destination(s) | | | | |
| Connecting Routes | | downtown | downtown | downtown |
| Scheduling Information | | | | |
| Days/Hours of Operation | | days | | days |
| Route Schedule | | | | |
| Frequency | | hi-freq rts | | hi-freq rts |
| Scheduled Next Bus - Electronic Board | | | | |
| Scheduled Next Bus - Text | | | | |
| Scheduled Next Bus - Web | | | | |
| Scheduled Next Bus - QR | | | | |
| Scheduled Next Bus - Call | | | | |
| Real-Time Next Bus - Electronic Board | | | | |
| Real-Time Next Bus - Text | | | | |
| Real-Time Next Bus - Web | | | | |
| Real-Time Next Bus - QR | | ltd | | |
| Real-Time Next Bus - Call | | | | |
| System Information | | | | |
| System Map | | | | |
| POI Guide | | | | |
| General Information | | | | |
| Fare Information | fare zone | fare zone | fare zone | fare zone |
| Safety Information | | ltd | ltd | |
| Public Message Board | | | | |
| Revision Date | | ltd | | |
| Website | | | | |
| Contact Information | | | | |
| Phone Number | | | | |
| TTY/TDD | | | | |
| Accessibility Information | | | | |
| Wheelchair Accessibility | | | | |
| Bicycle Accessibility | | | | |

## San Antonio, TX: VIA Metropolitan Transit (VIA)

**Information System Hierarchy:** Four-Tier

**Tier 1:** Low Information Sign – VIA employs a basic bus stop sign design with the agency logo featured prominently at the top, followed by route numbers, the customer information number, the website url, and the stop ID. VIA uses a bright red flag to denote when a bus stop has frequent service. Lastly, some stops list intersecting routes and the direction by which users can reach those stops to make the appropriate transfers. The signs exist at all stops outside of downtown area.

**Tier 2:** High Information Sign – VIA has premium stop signs and pylons in and around downtown San Antonio. These signs display the same information as the typical bus stop signs but also include the route name and destination. Like several transit agencies, VIA uses colors to differentiate service types, this color is present on these signs while it is absent on the basic bus stop sign. The colors also point to frequency.

**Tier 3:** Shelter – VIA signage treatment at shelters varies depending on their location. Many just include the low information sign with no other available information, whereas in Downtown these shelters have, in some cases, the system map, VIA streetcar maps, fare information, and even an electronic board with real-time next bus information at at least one stop.

**Tier 4:** Station – VIA transit centers have customer service offices, where users can pick up pamphlets for route and schedule information. They also display the system map with insets of the bus bay maps at each hub.

**Innovative elements**

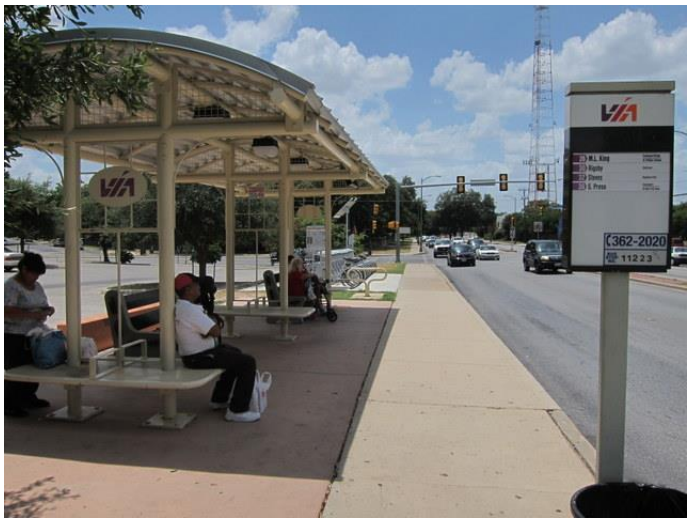
- **Trail Blazers for Connecting Routes**

  VIA uses trail blazers that indicate to bus operators which direction they should turn at certain intersections. Trail blazers of this ilk also indicate to users where they should make a transfer as these points exist at locations where routes diverge from each other. Although not all buses may stop at these locations, they are the represent the last opportunity to make a convenient transfer to a nearby stop.

**System Evaluation:** VIA has a basic information system outside of downtown San Antonio, providing relatively low levels of information at each tier until the station tier. However, like the other Texas transit agencies, its distribution of these hubs in its transit network, alleviates some of the issues associated with the lack of signage. Without the available pamphlets, users are not able to determine when to expect the next bus, plan a trip, or visualize where routes go outside of Downtown. Irregular users must rely on these materials.


FREQUENT SERVICE
20 46
67 68
79
362-2020
www.viainfo.net
BUS STOP NO.
19197
20
46
67
68
79
26
30
32
36


STREETCAR
MAIN LINE BUS
43 S. Flores
44 Pleasanton


362-2020


32 - STEVES SOUTH
Arrive 10 min

| San Antonio | Low Info | High Info | Shelter | Station |
|---|---|---|---|---|
| **Identification** | | Downtown | | |
| Stop ID | | | | |
| **Location Information** | | | | |
| Stop Location | | | | |
| Bay Locations | | | | |
| "You Are Here" Map | | | | |
| **Route Information** | | | | |
| Route Numbers/Name | | | | |
| Direction | | | ltd. | |
| Route Map | | | | |
| Destination(s) | | | | |
| Connecting Routes | nearby rts | nearby rts | nearby rts | |
| **Scheduling Information** | | | | |
| Days/Hours of Operation | | | | |
| Route Schedule | | | | |
| Frequency | hi-freq rts | | ltd. | |
| Scheduled Next Bus - Electronic Board | | | | |
| Scheduled Next Bus - Text | | | | |
| Scheduled Next Bus - Web | | | | |
| Scheduled Next Bus - QR | | | | |
| Scheduled Next Bus - Call | | | | |
| Real-Time Next Bus - Electronic Board | | | ltd. | |
| Real-Time Next Bus - Text | | | | |
| Real-Time Next Bus - Web | | | | |
| Real-Time Next Bus - QR | | | | |
| Real-Time Next Bus - Call | | | | |
| **System Information** | | | | |
| System Map | | | ltd. | |
| POI Guide | | | | |
| **General Information** | | | | |
| Fare Information | | | ltd. | |
| Safety Information | | | | |
| Public Message Board | | | | |
| Revision Date | | | ltd. | |
| Website | | | | |
| **Contact Information** | | | | |
| Phone Number | | | | |
| TTY/TDD | | | ltd. | |
| **Accessibility Information** | | | | |
| Wheelchair Accessibility | | | | |
| Bicycle Accessibility | | | | |

## San Francisco, CA: San Francisco Municipal Transportation Agency (MUNI)

**Information System Hierarchy:** Three-Tier

**Tier 1:** Sign – MUNI provides a customizable sign. It's base is the MUNI logo and "bus stop" below it. The remaining space on the sign is divided up into three or six spaces of a standard size, depending on the number of routes that serve the stop. This allows MUNI to apply decals over these spaces to provide the appropriate information. However, in part as a result of this format, there exist some discrepancies in what information is placed on the sign. Some signs have a stop ID with the number to call to find next bus information, others have detailed fare information, and still others have stopping restrictions for automobiles on signs. All signs display the route number, route name, destination, and approximate days and hours of operation for each individual route at the stop. These signs are found at all stops but major stations.

**Tier 2:** Shelter – MUNI adds a "You Are Here" system map with POIs and a frequency guide by day of the week for *all* routes in the MUNI system, which they brand as the "MUNI map".

**Tier 3:** Station – MUNI identifies stations and provides applicable bus bay maps. In addition, the agency incorporates information found in shelters in a redesigned format to fit much larger display cases and to accommodate other regional transit services that share use of the stations.

**Innovative elements**

- **System Map with Frequency Tables**

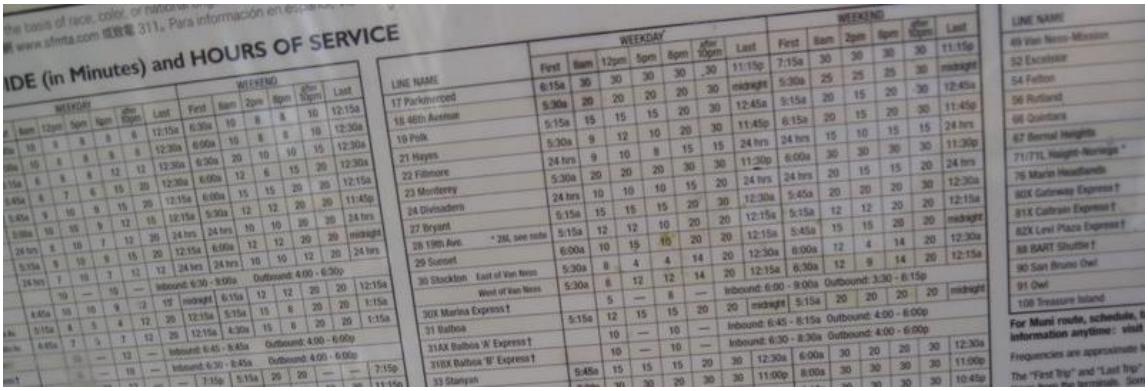
  The MUNI map is similar to many other system maps found in display panels; however, its addition of frequency tables and an inset map for late-night service make this map stand out. The frequency tables take into account different times of day and different days of the week and compile all of the routes together in a compact and easy-to-read manner. While this is not necessarily the best way to present schedule information for routes that have low frequencies, it is a strong planning tool for determining route selection based purely on headways and the probability of low transfer times. Since much of the MUNI bus routes have high frequencies, these tables are a workable substitute for individual route schedules, reducing space needs.

**System Evaluation:** At the basic bus stop level, MUNI provides differing levels of information that are fairly standard. However, at the shelter level, the amount of information is increased substantially due to the MUNI map. Due to the compact nature of the service area, this manner of distribution does not create major obstacles for most users. While route maps and route schedules are desirable, the system map and frequency tables are acceptable alternatives. The information system is cohesive and well-designed especially considering the limited space for display of more information.


STOP ID # 13144
8X 8AX 8BX 30 45 76
91
map
info


muni
bus stop
STOP ID 17665
NextMuni predictions: Call 511. Say, "Departure Times."
14 MISSION
To Ferry Plaza
Steuart & Mission
24 Hours Daily
14L MISSION LIMITED
To Ferry Plaza
Daily Approx 6AM-6PM
Sat/Sun 9AM-5PM
49 VAN NESS-MISSION
To North Point & Van Ness
Daily Approx 5:30AM-Midnight
TOW-AWAY
NO STOPPING ANYTIME
For Towed Cars Phone 553-1239


muni
bus stop
5 FULTON
No Smoking at Transit Stops
TOW-AWAY
NO STOPPING ANYTIME
Fares:


IDE (in Minutes) and HOURS OF SERVICE
LINE NAME
17 Parkmerced
18 46th Avenue
19 Polk
21 Hayes
22 Fillmore
23 Monterey
24 Divisadero
27 Bryant
28 19th Ave.
29 Sunset
30 Stockton
30X Marina Express†
31 Balboa
31AX Balboa 'A' Express†
31BX Balboa 'B' Express†
33 Stanyan
WEEKDAY
WEEKEND


TEMPORARY TRANSBAY TERMINAL
Station Map
Schedules & Fares

| San Francisco | Low Info | High Info | Shelter | Station |
|---|---|---|---|---|
| Identification | | | | |
| Stop ID | | | | |
| Location Information | | | | |
| Stop Location | | | | |
| Bay Locations | | | | |
| "You Are Here" Map | | | | |
| Route Information | | | | |
| Route Numbers/Name | | | | |
| Direction | | | | |
| Route Map | | | | |
| Destination(s) | | | | |
| Connecting Routes | | | | |
| Scheduling Information | | | | |
| Days/Hours of Operation | | | | |
| Route Schedule | | | | |
| Frequency | | | | |
| Scheduled Next Bus - Electronic Board | | | | |
| Scheduled Next Bus - Text | | | | |
| Scheduled Next Bus - Web | | | | |
| Scheduled Next Bus - QR | | | | |
| Scheduled Next Bus - Call | | | | |
| Real-Time Next Bus - Electronic Board | | | | |
| Real-Time Next Bus - Text | | | | |
| Real-Time Next Bus - Web | | | | |
| Real-Time Next Bus - QR | | | | |
| Real-Time Next Bus - Call | | | | |
| System Information | | | | |
| System Map | | | | |
| POI Guide | | | | |
| General Information | | | | |
| Fare Information | ltd. | ltd. | | |
| Safety Information | | | | |
| Public Message Board | | | | |
| Revision Date | | | | |
| Website | ltd. | ltd. | | |
| Contact Information | | | | |
| Phone Number | ltd. | ltd. | | |
| TTY/TDD | | | | |
| Accessibility Information | | | | |
| Wheelchair Accessibility | | | | |
| Bicycle Accessibility | | | | |

## Seattle, WA: King County Metro Transit (King County Metro)

**Information System Hierarchy:** Three-Tier + Limited Service Type Enhancements

**Tier 1:** Low Information Sign – King County Metro provides an advanced bus stop sign with a signpost panel. The sign shows a bus symbol and the word "BUS" with route numbers next to it. At the bottom of the sign is a wheelchair accessibility symbol for relevant stops. These bus stop signs and panels are found at all bus stops outside of downtown and stations.

**Tier 2A:** High Information Sign – King County Metro has installed high-quality signage and pylons throughout downtown Seattle. These signs have more general information, contact information, and accessibility information. The signs also include downtown area maps with frequent bus services. While the infrastructure expands the real estate on which information can be placed, the many routes that exist in Downtown absorb most of the space.

**Tier 2B:** BRT Shelter – Seattle's RapidRide service offers users premium facilities. These facilities include much of the same information found at stops with high information signs as well as route maps of the BRT service and electronic board signs with the real-time next bus information for BRT buses.

**Tier 3:** Station – King Metro builds on the infrastructure at its multi-modal stations providing the information found at the other tiers plus extra general information and information on means to acquire

scheduled next bus information. Stations have system maps to assist with trip planning as well. At stations along Seattle's transit tunnel, this information is displayed in a line one after the other, making the information visible and easy to find in one place.

**Innovative elements**

- **Modal Symbol for Bus Connections**

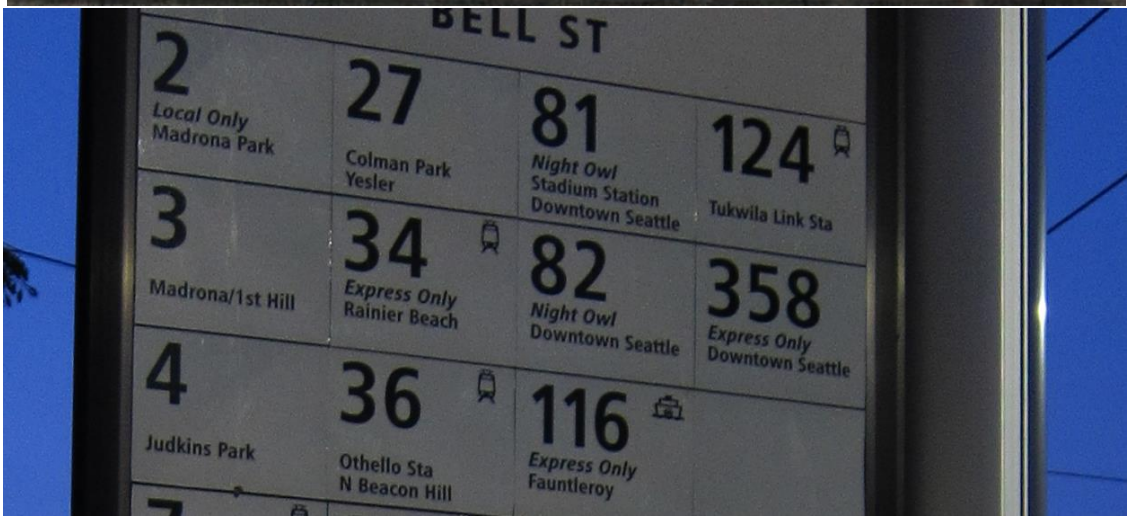
  Though a little utilized part of an element at King County Metro, the inclusion of a modal symbol next to route numbers on select signs in downtown Seattle allows users to filter out routes quickly when trying to determine which will take them to their destination. This is most useful when there are a large number of routes, which can burden a user and slow down decision-making.

**System Evaluation:** King County Metro has a clear and comprehensive user information system. The agency provides appropriate amounts of information at each tier, gradually increasing the number of resources at each level. Maps would be helpful at more locations for users who are not familiar with the geography of the region or who want a map to reassure route choices. Despite this limitation, the abundant schedule information and destination information is helpful for moving people throughout the service area regardless of bus stop.


BUS
17
26
28


Bus Bay B
East (SR 520)
255
DANGER
ALERT


Pioneer Square
BAY A
BAY A
BAY B
BAY C
BAY D
BAY D
How to use ORCA


BELL ST
2
Local Only
Madrona Park
27
Colman Park
Yesler
81
Night Owl
Stadium Station
Downtown Seattle
124
Tukwila Link Sta
3
Madrona/1st Hill
34
Express Only
Rainier Beach
82
Night Owl
Downtown Seattle
358
Express Only
Downtown Seattle
4
Judkins Park
36
Othello Sta
N Beacon Hill
116
Express Only
Fauntleroy

| Seattle | Low Info | High Info | Shelter | Station |
|---|---|---|---|---|
| **Identification** | | | | |
| Stop ID | | | | |
| **Location Information** | | | | |
| Stop Location | | | | |
| Bay Locations | | | | |
| "You Are Here" Map | | | | |
| **Route Information** | | | | |
| Route Numbers/Name | | | | |
| Direction | | | | |
| Route Map | | | brt | |
| Destination(s) | | | | |
| Connecting Routes | | | | |
| **Scheduling Information** | | | | |
| Days/Hours of Operation | | | | |
| Route Schedule | | | | |
| Frequency | | | | |
| Scheduled Next Bus - Electronic Board | | | | |
| Scheduled Next Bus - Text | | | | |
| Scheduled Next Bus - Web | | | | |
| Scheduled Next Bus - QR | | | | |
| Scheduled Next Bus - Call | | | | |
| Real-Time Next Bus - Electronic Board | | | brt | brt |
| Real-Time Next Bus - Text | | | | |
| Real-Time Next Bus - Web | | | | |
| Real-Time Next Bus - QR | | | | |
| Real-Time Next Bus - Call | | | | |
| **System Information** | | | | |
| System Map | | downtown | downtown | |
| POI Guide | | downtown | downtown | |
| **General Information** | | | | |
| Fare Information | add'l fare | | | |
| Safety Information | | | | |
| Public Message Board | | | | |
| Revision Date | | | | |
| Website | | | | |
| **Contact Information** | | | | |
| Phone Number | | | | |
| TTY/TDD | | | | |
| **Accessibility Information** | | | | |
| Wheelchair Accessibility | | | | |
| Bicycle Accessibility | | | | |

## Toronto, ON: Toronto Transit Commission (TTC)

**Information System Hierarchy:** Four-Tier

**Tier 1:** Low Information Sign – TTC provides a non-traditional bus stop sign as the basis of its system. This sign is vertical and concave. It provides users with information about hours of operation, safety information, the customer service number, the agency website url, and wheelchair accessibility information. Thus, it lacks any route information unless only one bus route stops despite multiple routes being on the corridor, in which case it says "Route [Number] Only". The signs are found at all bus stops except stations.

**Tier 2:** High Information Sign – The second tier offers a significant jump in the amount of user information. TTC adds signpost panels at these stops. These panels hold a simple diagrammatic route map with connecting bus and rail lines, a stop-specific route schedule with the route direction and destination listed as well as the stop location.

**Tier 3:** Shelter – TTC shelters use the high information sign to communicate most of the user information. They also leverage the space available on shelters to provide a system map facing the inside of the shelter with a large display panel. Some shelters have public message boards facing outward from this panel. These boards allow anyone to pin or staple anything to the board for public consumption.

**Tier 4:** Station – TTC stations include an electronic board showing real-time next bus information. They also have bus bay "You Are Here" maps and all the elements found at other bus stops except message boards.

**Innovative elements**

- **Sign Design Color**

  TTC bus stop signs have a red, blue, or red/blue striped bottom and top. These colors reflect the hours in which the buses that serve the stop are in operation. A red stripe indicates day only service, a blue stripe indicates night-only service, and red/blue stripes indicate 24 hour service. This is a clever way to demonstrate service without a schedule or when looking at a stop from a distance.

- **Bike Accessibility Symbol**

  TTC uses a simple symbol to show that buses have FMRs to hold bicycles for users. Unfortunately, the symbol is small and found on the upper left corner of the route schedules rather than on the bus stop signs themselves, but it is a unique way to display this information. It is useful for agency's that already depict a bus and want to provide bike accessibility information without using more space.

**System Evaluation:** Although TTC provides relatively little useful information for trip-making purposes at its low information signs, the agency installs a very large number of high information signs both inside and outside the downtown area. As a result, the user information system is very strong. The system works well

together, keeping the same style of route and schedule information through the latter three tiers leading to a very consistent system. TTC supplies users with many user-friendly tools to make trip plans and decisions.


| Toronto | Low Info | High Info | Shelter | Station |
|---|---|---|---|---|
| Identification | | | | |
| Stop ID | ltd. | ltd. | ltd. | |
| Location Information | | | | |
| Stop Location | | | | |
| Bay Locations | | | | |
| "You Are Here" Map | | | | |
| Route Information | | | | |
| Route Numbers/Name | rare | | | |
| Direction | | | | |
| Route Map | | | | |
| Destination(s) | | | | |
| Connecting Routes | | | | |
| Scheduling Information | | | | |
| Days/Hours of Operation | | | | |
| Route Schedule | | | | |
| Frequency | | | | |
| Scheduled Next Bus - Electronic Board | | | | |
| Scheduled Next Bus - Text | | | | |
| Scheduled Next Bus - Web | | | | |
| Scheduled Next Bus - QR | | | | |
| Scheduled Next Bus - Call | | | | |
| Real-Time Next Bus - Electronic Board | | | | |
| Real-Time Next Bus - Text | ltd. stcars | ltd. stcars | ltd. stcars | |
| Real-Time Next Bus - Web | | | | |
| Real-Time Next Bus - QR | | | | |
| Real-Time Next Bus - Call | | | | |
| System Information | | | | |
| System Map | | | | |
| POI Guide | | | | |
| General Information | | | | |
| Fare Information | | add'l fare | add'l fare | |
| Safety Information | | | | |
| Public Message Board | | | | |
| Revision Date | | | | |
| Website | | | | |
| Contact Information | | | | |
| Phone Number | | | | |
| TTY/TDD | | | | |
| Accessibility Information | | | | |
| Wheelchair Accessibility | | | | |
| Bicycle Accessibility | | | | |

## Vancouver, BC: South Coast British Columbia Transportation Authority (TransLink)

**Information System Hierarchy:** Three-Tier

**Tier 1:** Low Information Sign – TransLink uses an assortment of bus stop signs that qualify as low information stops. At worst, the signs have only a stop ID and wheelchair accessibility information; at best, the signs have a stop ID, wheelchair accessibility information, the route number, the destination, the customer service number, and the agency website url. These different bus stop signs were common in different areas, where higher density neighborhoods tended to have the higher information signs in this range and vice versa.

**Tier 2:** High Information Sign – TransLink uses the highest form of the low information signs at its high information sign stops at which it provides schedules in transparent cylinders. It should be noted that shelters may have low or high information signs like low information signs, they vary quite a bit.

**Tier 3:** Station – TransLink stations have high information signs along with more resources. This includes explicit information to access scheduled next bus information through remote resources. They also include the system map, stop and bay identification, and fare information.

**System Evaluation:** TransLink provides an inconsistent user information experience. Users cannot depend on information being available throughout the system as the information at stops varies so much even within tiers. While it is

possible to trip plan in the system, it is not always easy—or possible. High information stops and stations are generally useful, the other tiers are difficult to assess due to the variation.

| Vancouver | Low Info | High Info | Shelter | Station |
|---|---|---|---|---|
| Identification | | | inconsistent | |
| Stop ID | | | | |
| Location Information | | | | |
| Stop Location | ltd | | ltd | |
| Bay Locations | | | | |
| "You Are Here" Map | | | | |
| Route Information | | | | |
| Route Numbers/Name | ltd | | | |
| Direction | | | | |
| Route Map | | | | |
| Destination(s) | ltd | | | |
| Connecting Routes | | | | |
| Scheduling Information | | | | |
| Days/Hours of Operation | | | | |
| Route Schedule | | | | |
| Frequency | | | | |
| Scheduled Next Bus - Electronic Board | | | | |
| Scheduled Next Bus - Text | | | | |
| Scheduled Next Bus - Web | | | | |
| Scheduled Next Bus - QR | | | | |
| Scheduled Next Bus - Call | | | | |
| Real-Time Next Bus - Electronic Board | | | | |
| Real-Time Next Bus - Text | | | | |
| Real-Time Next Bus - Web | | | | |
| Real-Time Next Bus - QR | | | | |
| Real-Time Next Bus - Call | | | | |
| System Information | | | | |
| System Map | | | | |
| POI Guide | | | | |
| General Information | | | | |
| Fare Information | | | | |
| Safety Information | | | | |
| Public Message Board | | | | |
| Revision Date | | | | |
| Website | ltd | | | |
| Contact Information | | | | |
| Phone Number | ltd | | | |
| TTY/TDD | | | | |
| Accessibility Information | | | | |
| Wheelchair Accessibility | | | | |
| Bicycle Accessibility | | | | |

## Washington, D.C.: Washington Metropolitan Area Transit Authority (WMATA)

**Information System Hierarchy:** Three-Tier

**Tier 1:** Low Information Sign – WMATA utilizes a basic and compact sign for much of the agency's stops. This sign includes the customer service number prominently above associated route numbers.

**Tier 2:** High Information Sign – Upgraded signs include this information set in a different layout with a stop ID and the website url to find next bus information either by call or web. These signs include panels as well, which vary in size and number of sides. The signpost panels have schedule information that show times for the entirety of routes rather than providing stop specificity. These signs are found in high traffic areas and at shelters and stations.

**Tier 3:** Station –WMATA uses high information signs at bus bays along with large display panels with area maps that show the extent of routes that depart from that station, forming a geographic spider map with POIs and an inset for a bus bay map or another large-scale map appropriate for pedestrians.

**Innovative elements**

- **Bus Information Panel at Stations –** WMATA offers customers one of the most feature-rich bus information panels at stations. It utilizes a "You Are Here" map that pulls in all routes that connect to the station and, with the relatively large scale as compared with a system map, WMATA

applies the necessary elements for an neighborhood map complete with POIs. Adjacent to this map is a smaller bus bay map, when applicable, or a local area map oriented around the station. Furthermore, a table lists the bus routes with the days and frequencies with which they run. Finally, the panel has fare, contact, and accessibility information. While information panels at stations are common, few have so many features nested in as compact a manner as that in WMATA. This frees up space on other panels for other information or advertisements.

**System Evaluation:** WMATA has an extensive information system that provides significant levels of information at the high information sign tier and above. The low information sign, while lacking, is manageable with the supplemental information available at shelters and high ridership stops throughout the system. WMATA faces a distinctive problem of information oversaturation that results from the existence of a large number of transit agencies that serve the region. Bus stop signs at or near transit hubs bombard customers with unrelated bus information with a heavy reliance on branding to differentiate agencies. This may lead to what some view as visual pollution and also may cause confusion with respect to the level of integration between the agencies. Overall, the customer information system is coherent and scales appropriately.


metrobus
call us for information
202-637-7000
32 36 54 A11
J13 P6 P17 P19
W13


22A Pentagon
via Shirlington
25A 25B 25E
Alight Only
metrobus
ART
703-228-RIDE
42


metrobus
call us for information
202-637-7000
32 34 36 39
A11
circulator
BUS STOP
902
904
907
995
Next Bus


Bus Stop#
4000493
For the
Next Bus
Call
(202) 637-7000
or visit
wmata.com
AT7
SCHEDULE
Westbound
DASH


Bus Information
Bus Information From
King Street Station

| Washington, DC | Low Info | High Info | Shelter | Station |
|---|---|---|---|---|
| Identification | | | | |
| Stop ID | | | | |
| Location Information | | | | |
| Stop Location | | | | |
| Bay Locations | | | | |
| "You Are Here" Map | | | | |
| Route Information | | | | |
| Route Numbers/Name | | | | |
| Direction | | | | stn=origin |
| Route Map | | temp ltd. | temp ltd. | |
| Destination(s) | | <3bus@stop | <3bus@stop | |
| Connecting Routes | | | | |
| Scheduling Information | | | | |
| Days/Hours of Operation | | | | |
| Route Schedule | | | | |
| Frequency | | | | |
| Scheduled Next Bus - Electronic Board | | | | |
| Scheduled Next Bus - Text | | | | |
| Scheduled Next Bus - Web | | | | |
| Scheduled Next Bus - QR | | | | |
| Scheduled Next Bus - Call | | | | |
| Real-Time Next Bus - Electronic Board | | | | |
| Real-Time Next Bus - Text | | | | |
| Real-Time Next Bus - Web | | | | |
| Real-Time Next Bus - QR | | | | |
| Real-Time Next Bus - Call | | | | |
| System Information | | | | |
| System Map | | | | |
| POI Guide | | | | |
| General Information | | | | |
| Fare Information | | | | |
| Safety Information | | | | |
| Public Message Board | | | | |
| Revision Date | | | | |
| Website | | | | |
| Contact Information | | | | |
| Phone Number | | | | |
| TTY/TDD | | ltd. panels | ltd. panels | |
| Accessibility Information | | | | |
| Wheelchair Accessibility | | | | |
| Bicycle Accessibility | | | | |

# REFERENCES


American Public Transportation Association (APTA). 2012. Transit Ridership Report – Third Quarter 2012. Retrieved January 6, 2013 from http:// http://www.apta.com/ resources/statistics/Documents/Ridership/2012-q3-ridership-APTA.pdf

Cain, A. 2007. Are Printed Transit Materials a Barrier to Transit Use?. *Journal of Public Transportation* 10 (2): 33-52.

Calori, C. 2007. *Signage and Wayfinding Design*. Hoboken, NJ: John Wiley & Sons, Inc.

comScore. 2012. comScore Reports June 2012 U.S. Mobile Subscriber Market Share. Retrieved September 8, 2012 from http://www.comscore.com/Insights/Press_Releases/ 2012/8/comScore_Reports_June_2012_U.S._Mobile_Subscriber_Market_Share

Denis, M. 1997. The Description of Routes: A Cognitive Approach to the Production of Spatial Discourse. *Current Psychology of Cognition* 16: 409-458.

Dobies, J. 1996. Customer Information at Bus Stops. *TCRP Synthesis of Transit Practice 17*. Washington, DC: TRB, National Research Council.

Earnhart, G., 1996. Guidelines for Transit Facility Signing and Graphics. *TCRP Report 12*. Washington, DC: TRB, National Research Council.

Higgins, L. and Koppa, R. 1999. Texas Transportation Institute and NuStats International. Passenger Information Systems: A Guidebook for Transit Systems. *TCRP Report 45*. Washington, DC: TRB, National Research Council.

Iseki, H. and Taylor, B.D. 2010. Style versus Service? An Analysis of User Perceptions of Transit Stops and Stations. *Journal of Public Transportation* 13 (3): 23-48.

Lyons, G. 2006. The Role of Information in Decision-Making with Regard to Travel. *IEE Proceedings of Intelligent Transportation Systems* 153 (3): 199-212.

Nielson. 2012. Two Thirds of New Mobile Buyers Now Opting for Smartphones. Retrieved September 8, 2012 from http://blog.nielsen.com/nielsenwire/online_mobile/ two-thirds-of-new-mobile-buyers-now-opting-for-smartphones

Turnbull, K. F. 2003. Transit Information and Promotion. Chapter 11. Traveler Response to Transportation System Changes. *TCRP Report 95.* Washington, DC: TRB, National Research Council.

Tversky, B. 2000. Levels and Structure of Cognitive Mapping. In R. Kitchin and S. M. Freundschuh (Editors). *Cognitive Mapping: Past, Present and Future*. London: Routledge, 24-43.

Tversky, B. and Lee, P.U. 1998. How Space Structures Language. In Freksa, C., Habel, C., and Wender, K.F., Editors., *Spatial Cognition: An Interdisciplinary Approach to Representation and Processing of Spatial Knowledge*. Berlin: Springer-Verlag, 157-175.

United States Access Board (Access Board). 2004. Americans with Disabilities Act and Architectural Barriers Act Accessibility Guidelines, Washington, DC: U.S. Architectural and Transportation Barriers Compliance Board.

United States Department of Transportation (USDOT). 2010. Americans with Disabilities Act Standards for Transportation Facilities, Washington, DC: U.S. Architectural and Transportation Barriers Compliance Board.

Wenzel, P. 2004. *Signage Planning Manual: Planning Aids for the Design of Pedestrian Signage Systems*. Huenstetten, Germany.